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Mastering Power Production-VII

Task Work With Bonus is the Only Scientific Way to Pay Additions to Regular Wages

By Walter N. Polakov

The author gives a searching analysis of four methods that have been used in power plant practice to pay additions to regular wages. These are: Profit sharing, premium plans, rewarding individual efforts, task work with bonus. He then goes on to declare that the last is the only scientific method, and gives a number of significant examples of successes and results from its application.

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated abroad, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he became a consulting engineer to the Board of Estimate and Apportionment of the City of New York, then consulting engineer for the Penn Central Light & Power Company and later was superintendent of electric power of the New York, New Haven and Hartford Railroad Company.*

THE cry for an *equality of wages* rests upon a mistake. It is an insane wish, never to be fulfilled. It is an offspring of that false and superficial radicalism that accepts premises and tries to evade conclusions. It has been shown before[1] that under the existing wage system the value of labor power is determined like that of every other commodity, namely by the cost of its production. Inasmuch as the cost of producing labor power of different quality differs, so must the values of the labor employed differ in the different trades; moreover, since it requires more time and energy to acquire a superior skill even within the same trade or class of work, these differences must fetch different prices in the labor market. This conclusion cannot and must not be evaded and any other argument is either unscientific, as not based upon facts, or superfluous.

BONUS IN RELATION TO SKILL

As long as we admit the fact of inequality of skill and corresponding inequality of the value of labor, we are facing a new problem. Should the labor power or superior skill be permanently rated at a higher figure, or should it vary as this skill makes itself manifest? Obviously the question in this form confuses two distinct propositions. In every trade at any time there is a certain accepted average skill qualifying the man to do his work. In this sense the difference between the values of labor power of a window cleaner and an engineer is permanent. Opposed to that we observe a difference between two window cleaners; one of superior skill can wash equally well a treble glass surface within the same time and using less supplies than another; or, again, one fireman can produce the same amount of steam of the same quality and pressure with less fuel than another due to his superior skill in selecting and maintaining the more favorable conditions. The moment we pay both men the same wages, we underpay the man of superior skill. Should we then decide to increase his rate according to his additional dexterity, we pay not for the value we receive but merely for the potential value he possesses. In other words, whereas difference in value of labor engaged in different occupations remains permanent so long as there is a difference in the general requirement of the work, the difference based on the degree of skill in the same occupation is manifest only when actually exercised.

The inevitable conclusion thus arrived at is that any degree of skill above the average of a given trade or occupation must be actually measured each time it is applied. The price paid for such surplus skill is the bonus or additional compensation in excess of the wage rate accepted for the labor power in the given trade.

BONUS IN THE POWER PLANT

To assist the employee to acquire the highest possible degree of skill was previously described as a specific function of the management. Those who acquire the skill and the habit of applying it to their work are entitled to a bonus which thus appears as a reward to those who learn, while it is really nothing else but the value of additional service rendered. It is appropriate at this juncture to note the fact that the cost of producing this additional skill (comparable to the revenue producing investment) is shared by the employer through providing for the training and education of the employees, hence his claim for a share of the added value of the labor.

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[1] "Mastering Power Production—IV," INDUSTRIAL MANAGEMENT, [illegible] April, page [illegible]

With this economic principle clearly established it is comparatively easy to trace the typical fallacies prevalent in various modes of payment and differently named additions to the regular wages of power-plant employees.

Practically all of these methods were devised to stimulate power-plant employees to do better work and to relieve the management of the responsibility for training and guiding the men. Improper methods unfortunately are used often enough to discredit the correct underlying principle in the eyes of those who do not care to study the question in its entirety, be they owners, managers, or the laboring men. For the sake of simplicity all these plans may be classified into four principal groups:

1. Profit sharing.
2. Premium plans.
3. Rewarding individual efforts.
4. Task work with bonus.

The first attempt in this country conducted on a large scale to secure operating economies in power plants was made about 15 years ago on the Atchison, Topeka & Santa Fé Railroad. The primitive method used is of interest chiefly by way of contrast with the 10 years' development in the art. It was recognized that:

1. The actual performance was worse than the possible.
2. Local conditions of various plants call for different standards.

The work of establishing standards of performance was based not on actual experiments, but on average statistical data of the past, reduced by a guessed percentage suspected as waste. Then an allotment was made for each individual plant as to how much fuel should reasonably be consumed there per month. Similarly pay-rolls were revised and certain labor costs were assumed as reasonable. These two records multipled by constants arbitrairly set (six for fuel and four for labor) added together and divided by ten gave the figure of merit used as a basis for the payment of bonus, the bonus itself being adjusted on a sliding scale. The shortcomings of this crude method are apparent:

1. Men were left to discover for themselves how to secure the results desired by the management.
2. The management, shifting the responsibility to the men, was itself uncertain as to the exact amount of saving accomplishable due to individual efforts and, therefore, could not fix a definite bonus.

The results accomplished by the Santa Fé men were, however, sufficiently satisfactory to the management and, not burdening itself with further responsibilities, the management still maintains this method.[2]

Numerous other attempts were made by other concerns producing power, either for their own use or for sale, to organize the management along lines more definite than a mere request of the men "to do better." Inasmuch as the largest portion of power operating expense is for fuel, the first efforts to secure economy were made in the boiler plants.

Various schemes have been used as the basis of task setting for firemen, most of which to the writer's knowledge have proved highly unsatisfactory.

Profit Sharing

Little is to be said regarding various schemes of *profit sharing* as these are, properly speaking, the attempts to camouflage the basic opposition of interests of labor and capital. Broadly speaking, any plan to make the employees participate in the company's dividend aims at instilling the spirit of unity of interests of employer and employees, and generally fails for the reason that the matters of management are not under the control of the employees. So long as the form of governing the affairs of the enterprise remains autocratic, even though they may be benevolent and paternalistic, the employees clearly realize their inability to participate materially in securing the success of the enterprise. Such mutuality of interests could rightfully be expected if the employees had the opportunity to control all functions of management, fix salaries of directors, direct purchases, investments, sales and generally have a hand in all financial transactions. But then the organization would become a cartel or coöperative and the "profit sharing" will lose its identity, workmen not being employed would receive full value of their labor and not share it with their employers. So long as they are expected, however, to work under the conditions provided by the management serving the interests of the owners, using the equipment and materials furnished by the employers, who in turn dispose of the product, carry out all outside negotiations without council and consent of the employees, the profit and loss of the enterprise is influenced only in a very slight degree by the excellence of the work done by the men. If for any reason whatever the dividends are not declared, the workmen lose their share, perhaps through no fault of their own, since even if they have been working as well as possible, blunders in policy and mismanagement, overequipment, idle charges, stock gambling and what not, could easily offset any advantage of the splendid efforts of the men themselves.

Nevertheless there are instances on record showing both financial success and freedom of internal friction in the companies adopting profit sharing plans of compensating employees. These are easily to be traced to the more direct and unquestionable value of a higher wage-scale and more sincere interest in the well being of the employees and not to profit sharing proper. In fact there is probably a much larger number of cases on record where the profit sharing plan unaccompanied by guaranteed high pay and welfare work causes endless troubles, discontent and even strikes. Particularly unfortunate are experiences where companies have forced the employees to invest in shares, real estate, etc. In all cases, however, the profit being not necessarily the result of the good work of the men has little to do with direct stimulation for learning the best way of doing the work and acquiring commendable habits of industry.

Premium Plans

A close resemblance to profit sharing is manifest in the Edison and Lewis bonus schemes for the power-plant force based on the ultimate cost of power.

A number of years ago a portland cement company put the firemen, mostly skilled, industrious Portuguese, on a "premium" plan whereby their work was judged by the cost of steam generated and premium offered for its reduction.

To no surprise on our part, the scheme proved to be a failure and was abandoned, chiefly upon insistence of the men themselves who clearly conceived what the inventors failed to see. The common error of all premium plans is that the ultimate result, or cost of operation, is taken as a basis for award or denial of the premiums. It fails to recognize and take due cognizance of the following influential elements:

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[2] See proceedings of the International Engineering Congress.

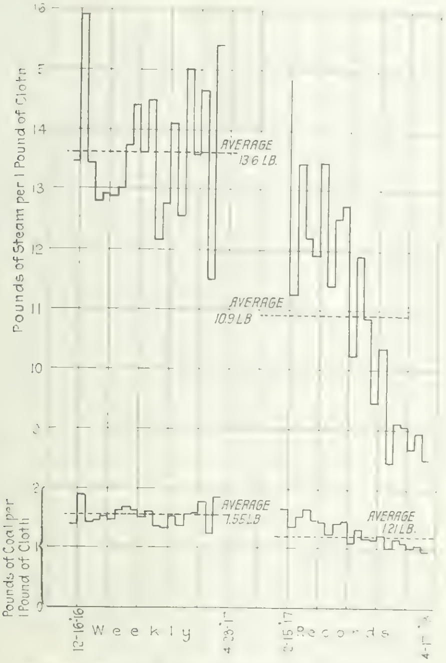

FIG. 23. CHART OF STEAM AND COAL CONSUMPTION

Cost is affected by,

1. Price of materials used.
2. Quality of materials used.
3. Maintenance of equipment.
4. Local characteristic.
5. Volume of output.
6. Operating methods.

Obviously the first five factors are not under the control of the firemen, engineers, laborers or switchboard operators, even the plant superintendent seldom has full charge of these conditions, therefore any attempt to judge the work of operating men from the viewpoint of costs is a shortsighted placing of responsibility where it does not belong. Furthermore, wherever operating factors only are taken into consideration, the determination of premiums for the entire personnel does not differentiate among shifts, crews or men; yet it is quite evident that the extent to which different employees contribute to the attainment of economical results is very unequal. While firemen can cause as much as 50 per cent. fluctuation of fuel consumption, all the rest of the power-plant employees could influence the operating cost but slightly.

A similar misconception caused by insufficient familiarity with facts is manifest in a recent application of a premium plan to a bleachery plant by Mr. Lewis. Fixing premiums on the basis of power consumed per unit of manufactured output is working on the wrong premises inasmuch as the perfection of power generation is thus inseparably mixed with the efficiency of:

1. Power distribution,
2. Manufacturing equipment,
3. Bleaching processes,
4. Kinds of goods handled,
5. Output of finished goods, etc.

Figure 23 illustrates an actual case of steam and coal consumption per one pound of cloth bleached. The reduction observed does not in any way reflect on the efficiency of the boiler-room operation and there could not be any reason why the firemen should get premium if the saving is due entirely to the improvements in distribution and use of steam, stopping the leaks, etc. Such and similar half-baked, short cuts largely contribute to bringing into disrepute the schemes of paying premiums without analyzing in detail and fixing the responsibility for the contributing factors.

REWARDING INDIVIDUAL EFFORTS

The principle of rewarding men for their efforts in securing operating economy and improving methods, while they sometimes bring about a measure of improvement, cannot and never do accomplish in full measure the elimination of preventable wastes. Such falling short of the possibility is primarily due to the "gentleman's understanding" that the firemen and coal passers know more about the science and practice of economical operation than the engineering staff and the management. When the men are simply told "to do better" and left alone to struggle and solve the problem in order to receive a promised reward, it is a sign of weakness of organization, a case where the management fails to manage.

The reason for the inability of this plan to produce better results lies in the fact that shifting the responsibility for securing better results by the management onto the men, does not carry with it the necessary authority to adjust and control all the influential factors. Men cannot alter the conditions under which they are expected to produce results. Men seldom have sufficient power of reasoning for detecting the harmful causes. Men never have enough time and facilities to analyze, plan and adjust the conditions the way they should be—and if they can and do the nominal management becomes an ornamental adjunct of the organization.

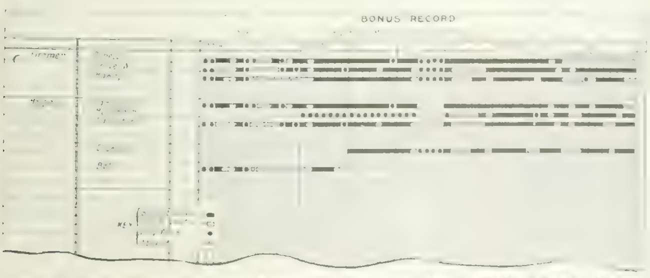

FIG. 24. CHART SHOWING BONUS RECORD AND [illegible]

The previously cited Santa Fe bonuses have all the ear marks of the method of rewarding individual effort. More recent attempts are exemplified by O'Neill's methods and Manila Electric Company's practice.

The most frequent error in application of this reward system is an arbitrary selection of one or more isolated factors. The high carbon dioxide in the flue gas, low carbon content in ashes, and rewarding men for obtain ing these results. The interrelation of a plurality of factors is for simplicity's sake overlooked, and the final results are frequently more unsatisfactory than before.

In my paper on "Bonus for Firemen"[3] I maintained that "if one of the advocates of these short cuts would take pains to investigate any of his hobbies—whether high CO_2, or low flue temperature, or good ashes, or anything else that can be produced—he would find that the complexity of influential factors is sufficient to warrant a long step toward detail study."

Five years later *Power* published an article describing Mr. H. O'Neill's method of determination of bonuses for boiler plant operatives[4] based on the combination of the three above mentioned factors. Some day, we hope, another revelation will be made announcing that "something else" is to be taken into consideration. The pathos of this plan, however, is reached with the announcement that, "the division of the bonuses to individual men is *left to the judgment* of the management." A truly frank admission that the management is not based on facts and does not know, therefore, how to measure accurately the contributing effect of the work of firemen, cleaners, repair-men, etc.

A step forward in this direction is made at the Manila Railway & Light Company's[5] plant, where the proportion of bonus received by each "varies with their responsibility, or *the degree* in which their duties offer an *opportunity* to save coal." Whether the opportunity was actually seized remains, however, uncertain. In accordance with the Blaisdell plan a water tender receives 10 points, a fireman 6 points, an oiler or coal passer 3 points, etc.; but, similar to the Santa Fé case, there is no definite reason why such an arbitrary favoritism should not be challenged. While Blaisdell's method is based on the most unfit principle of dumping without analysis all causes and all individuals reckoning the efficiency of all stages of the process of power transformation and generation in the final terms of thermal efficiency (number of B.t.u. per k.w.h. on the switchboard) and finally apportioning the spoils of this battle royal for efficiency at fanciful ratios, there is still another factor deserving mention. The competition among the members of a "watch" is not encouraged because of impossibility created by the fact that only final all-around efficiency is measured, but the rivalry between the three "watches" is fostered to the extent that the best gang takes away from the others 10 per cent. of their bonuses. This forfeiture of earned bonuses discloses another weakness of the entire plan—if one gang accomplished the results entitling it to a reward it deserves it as well as the other gang that exceeds the required results. Again, if certain records are entitled to higher rewards than some others, the graduation of rewards should be fixed permanently. As it is, the same quality of work fetches different compensation.

In other words, if the value of "good" work is depreciated by comparison with "better" work, it means that the whole system lacks clear conception as to what constitutes the work and what it is worth. The result of two and one-half years of practicing this plan claims 18.5 per cent. fuel saving, but only 50 per cent. of it is "due to the efforts of the employees," the rest of the saving being brought about through physical improvements. These meager results ("the present saving in fuel cost is 8.75 per cent.") are nevertheless higher than most of the plants adopting reward-payment based on some similar misconception can claim.

Opposition to Bonus

From time to time an opposition springs up, denouncing the payment of bonus for some reason or other. The opposition that comes from the laboring quarters is just as much due to that false and superficial radicalism that insists on equality of wages, thus unconsciously supporting the mediæval idea of guild, as to the legitimate criticism of the evil resulting from ill-applied principles. It is particularly justified in my opinion where the bonus is designed to be a stimulus for increasing man's production beyond the safe limit, as far as the man's health and happiness are concerned. In case of power plant work, it is obvious that such criticism is without ground since the task is based on the quality, not the quantity of the work done, and if properly carried out does invariably result in reducing physical strain and better balancing of the mental and physical efforts.

The opposition that is sometimes heard from the employers is not infrequently prompted by the desire to secure greater advantage from the labor without sharing with them any of the benefits derived therefrom.

Recently, when following the lead of the work done in power plants, the measurement of the quality of work was introduced in some industries, it was noted that the pride in accomplishment created friendly coöperation and sporting spirit among the employees which alone produced better results. This fact has given a new argumentation to the opponents of bonus as they can get along without it by merely playing on human nature. While such evasions of the basic economic issue are sometimes capable of producing temporary results, yet it is certain that any benefit thus secured could never be permanent, as would soon be demonstrated.

Task Work With Bonus

Opposed to all these schemes, we base our bonus payment on the following basic facts:

1. The value of labor power increases with increased skill.
2. Each occupation requires different skill along distinct lines.
3. Higher skill is manifest from suitable records for each phase of power-house work.

Therefore, the duty of the management is to:

1. Definitely determine what results can be expected from the exercise of skill above the average in each branch of work (task setting).
2. Assist the employee to acquire the desired high degree of skill (training).
3. Provide the conditions under which the skill may be practiced to advantage (standardizing).

When this is laid at the bottom of the system of management those employees who demonstrate the higher skill (acquired and applied) receive bonus. *Thus the bonus is neither a gift nor an inducement, but payment for the value of additional skill.*

As to the part which the bonus payment plays in the plan of management *it is neither an aim nor a means:* it is a *consequence* of the postulates exposed in the preceding studies.

The bonus is thus obviously unseparable from the task as it is paid for accomplishment of the task. In turn, the task cannot, as a rule, be lived up to by an untrained man, thus the earning of bonus depends on the education and training of the employee and a regular earning of bonus indicates that the new, better mode of operating is rooted as a fixed industrial habit. Again, setting the task presupposes preliminary scientific research establishing with certainty *what* can be accomplished and what should be accomplished before the bonus is paid. In the course of this task-setting the management devises the method of *how* the desired and possible results could be secured so that the bonus may be earned. Finally, in the course of these researches. task setting and training, the conditions beyond the control of task workers are disclosed and the management assumes the responsibility for providing the opportunities to the men for earning bonus without the interference of outside causes.

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[3] American Society of Mechanical Engineers, *Transactions*, 1913, paper No. 1401, and address before the Taylor Society, December, 1916.

[4] "Bonus Plan for Boiler-plant Operatives," *Power*, April 2, 1918.

[5] Aera, February, 1918, "A Bonus System for Power Houses."

Broadly speaking, the introduction of task work with bonus involves the gain of a thorough knowledge of all factors bearing upon the mastering of power production. As such knowledge is gained, division of responsibility is clearly drawn not only between those managing the plant and performing routine work, but it distinctly differentiates the duties, responsibilities and results among operatives (either individuals or small teams). *The earning of bonuses established on this basis is, therefore, an indication to what degree the management succeeds in organizing and maintaining the coöperation of the men with each other and with the management for the common good.*

In this connection emphasis should be laid on the fact that while each class of work in a plant has a definite hourly rate of pay, the bonus is commensurate with the relative value of additional skill. Thus each man receives a definite amount of money as bonus determined for the kind of work he was doing, over and above his guaranteed daily wage, if the task was lived up to.

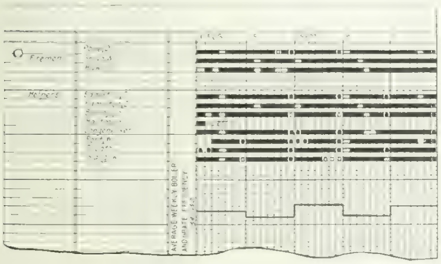

FIG. 25. BONUS EARNINGS AFTER SEVERAL MONTHS' TRIAL

So long as the conditions of task work and method described in the instruction card remain the same, the bonus does not vary, inasmuch as the casual peaks above the normal task-result represent not the extra skill but an accidental combination of minor favorable circumstances (since it is evidently an unprofitable undertaking, for instance, to account for all endless minute influences of such details as moisture in the air, direction of wind, barometric pressure, endothermic reaction of elements in the ash, etc., on the boiler efficiency). On the other hand, the coöperation of men with the management is further promoted by an invitation for suggestions, leading to the improvement of already devised methods. These, if proved superior to the standard practice, bring to the originator a special reward.

Again, as has been stated before, the instructor's, or head fireman's, or chief engineer's bonus depends on his skill as an instructor—each time anyone of his "charges" earns bonus, he gets a corresponding reward which is materially increased for the days when his skill as leader and instructor is crowned with success of helping all under his care to earn their bonus.

What Gantt said in regard to the industrial establishment appears to be even more applicable to the power industry: "The general policy of the past has been to drive, but the era of force must give way to that of knowledge, and the policy of the future will be to teach and to lead, to the advantage of all concerned."

Our social relations are approaching now the stage when German military discipline is unthinkable in the shops and power plants. The men want to do things in a right way, but time and again it has been demonstrated that labor will not stand for arbitrary rule, particularly if it comes from incompetent quarters. Again, in the power industry, where every process and every operation is clearly defined by unrepealable laws of nature, there is no room nor excuse for any form of management that is not based upon those laws. We need no lawyers nor courts to support the laws of gravitation, of chemical affinity or of electrical phenomena. The management system mastering production in accordance with similar elemental laws needs no other force for backing but the knowledge of facts.

In my address before the Taylor Society at the annual meeting in 1916, I touched upon this subject:

> The advocates of strict military discipline are apt to imagine that the new habits can be forced on the men by fear of dismissal or milder disciplinary measures. This may work so long as the men do not see their way out of the pressure, which usually does not take very long; then the newcomers must be forced into the régime at a great expense of time and energy. Meanwhile an elaborate system of espionage, bossism and pressure must be brought into play if the rule is really to be enforced, otherwise the things are done in the prescribed manner only while men are under surveillance, or more often it only appears so to the casual observers and to the imagination of the advocates of "big stick" rule.

The obvious advantages of leading and teaching are:

(a) Less effort is needed to lead than to push.

(b) Voluntary actions are performed even when not watched, therefore when the correct method is convincing and formed into habit the best results follow permanently.

(c) The coöperative spirit is developed rapidly and from within thus insuring its perpetuation.

(d) The expenses of study, training and bonus are covered by a fraction of the savings accomplished, whereas the expenses of forcing and overseeing are not, a fact not always realized.

APPLICATION OF BONUS SYSTEM

As has been stated before, the fact whether the task was lived up to may be reckoned in terms of the quality (efficiency) of work or results. This is true, however, only on the condition that the results were not affected unfavorably by some adverse unstandardized conditions, the removal of which was not within the power of the bonus worker affected. Whenever such circumstances are met with it is the duty as well as the privilege of the task worker immediately to report such handicap to the proper party. It is to a distinct advantage of the management to correct the trouble before it gains headway. If, however, the ill effect of poor repair, wrong instrument indications, poor supply or error in instruction was not apparent to the task worker until after the results are computed, it becomes the task of the supervisor to investigate each case of apparent loss of bonus before or at least as soon as the man returns to his work. In this manner the cause can be allocated in time to prevent more serious loss and so protect the man from injustice. If it was ascertained that the fault was not with the man the management allows him his bonus thus standing the penalty for failure to provide proper conditions for economical operation.

During the period of instruction the men are given demonstrations that by following the instruction cards, proper interpretation of instrument readings, etc., the accomplishment of the task-results is entirely feasible [illegible] man, but to any one who closely observes the requirements. When this fact is convincingly presented and accepted by men, their willingness to improve and attain the task is usually very keen, but repeated failure to earn bonus (if the training was not long enough to form the habit) sometimes is so discouraging as to be a menace to ultimate success. No effort should be spared on the part of the instructor, who must stay with one man or a team until it is quite evident that the new mode of working and thinking becomes a sort of a second nature with the task worker. When one shift is working successfully on the new plan, earning bonus a portion of the time and convinced that it is the honest intention on the part of the company to continue to pay a fair bonus, the work of starting other teams and men on other watches is a great deal easier, as the elements of personal pride, ambition and new *esprit de corp* accelerate the progress.

The bonus record chart Figure 24 shows the progress in starting on task work with bonus in a boiler house of a public utility plant, showing remarkably quick progress in learning, especially considering that most of the firemen had no previous experience except in farming.

The chart, Figure 25, shows the bonus earnings in the same plant several months after the work was started there and indicates the uniformity of results obtained.

On the other hand the chart of Figure 26 illustrates a slow beginning in the forming of a habit of efficient work. During the first week on the record no fireman succeeded in accomplishing his task. The next weeks show 50 per cent. of men earning their bonuses, though the efficiency of boilers and grates remained for the weekly average still below 66 per cent. Two months after the bonus is earned regularly in about 90 per cent. of the cases and the weekly average efficiency is 75.5 per cent. While the efficiency at the start was higher than an average in similar mill plants, 16 per cent. improvement in method represent an annual saving of 2,500 tons of coal, equivalent to some $15,000, while the amount paid as bonus is but a small percentage of this sum, thus justifying the system tried.

Some Results of the Application of Task Work With Bonus

To show what results have been accomplished it might be of interest to outline briefly a few typical instances.

Several years ago, the writer was consulted regarding the contemplated additional installation of boilers in a plant furnishing a bleachery with steam and power. The plant contained 10 Manning boilers equipped with Jones underfeed stokers. A survey of the method of operating the boilers resulted in the condemnation of the plan of adding new equipment and, today, in order to handle a materially increased output of the bleachery on the average, only seven of the 10 old boilers are used. The efficiency at the start had been found not to exceed 50 per cent. and the men doing hard work on an excessive number of boilers were unguided with any instruments or instructions. The installation of necessary instruments on the boiler control board enabled the writer to start the necessary studies, and the result of training the men in the intelligent use of instruments raised the boiler efficiency from 50 to 60 per cent.

Further progress was made with the able assistance of the plant supervisor and the weekly average of boiler efficiency was finally built up to about 73 per cent. See Table 1 herewith. Still further progress was made along the lines of reducing steam consumption through more efficient means of distribution and utilization of it.

TABLE I.—TWO TYPICAL REPORTS SHOWING INCREASE OF EFFICIENCY FROM ADOPTION OF METHODS OUTLINED IN TEXT

CASE I

	Representative Week 1917 (Nov. 17, 1917)	Corresponding Week 1916 (Nov. 18, 1916)
Total coal used, lb.	441,280	506,240
Coal equivalent in shavings, lb.	31,350	38,450
Total fuel used, lb.	472,630	544,690
Total water evaporated, lb.	4,901,170	4,625,250
Actual evaporation, lb. per hour	10.37	8.51
Average steam pressure	58	56
Average feed, temperature, F.°	170	168
Factor of evaporation	1.073	1.075
Equivalent evaporation from and at 212 degree Fahr., lb. per lb. coal	11.12	9.15
Average B.t.u. per lb. coal	14,800	13,550
Boiler efficiency, per cent.	72.9	65.6

CASE II

	Representative Week 1917 (Nov. 24, 1917)	Corresponding Week 1916 (Nov. 25, 1916)
Total coal used ,lb.	452,480	526,400
Coal equivalent in shavings, lb.	29,700	40,350
Total fuel used, lb.	482,180	566,750
Total water evaporated, lb.	5,045,800	4,837,800
Actual evaporation, lb. per hour	10.45	8.55
Average steam pressure	58	57
Average feed temperature, F.°	163	176
Factor of evaporation	1.081	1.067
Equivalent evaporation from and at 212 degree Fahr., lb. per lb. coal	11.30	9.12
Average B.t.u. per lb. coal	14,800	13,550
Boiler efficiency, per cent	74.0	65.4

Figure 23 previously referred to shows that about one-fifth of the coal previously consumed for no useful purpose was saved.

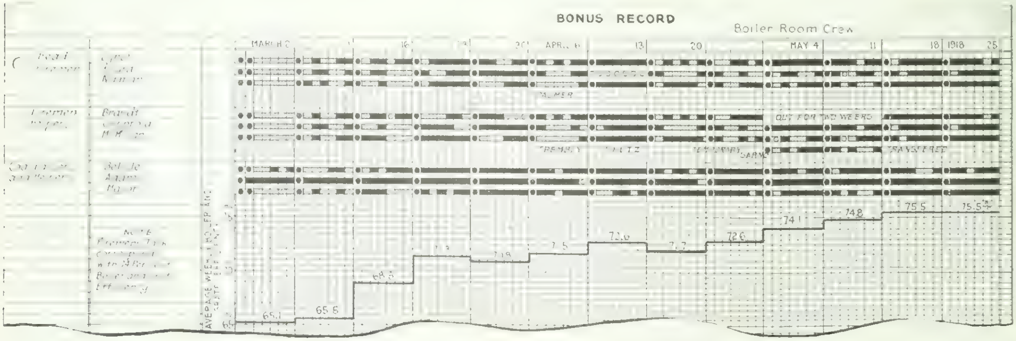

FIG. 26. BONUS RECORD CHART, SHOWING ATTAINMENT OF HIGHER EFFICIENCY AFTER A RATHER SLOW BEGINNING

In a Pennsylvania public utility company[6], where the average efficiency as established by an 80-day observation of hand-fired Edgemoor boilers was 54 per cent., without any expense for improvement or additions to the generating equipment and with only a few additional instruments, the writer's methods, comprising the task work with bonus, improved the average daily performance about 33 per cent.

The superintendent of this plant, Mr. J. C. Scholl, in a paper read before the Pennsylvania Electric Association, makes the following statement:

> The experiments were made at the Warrior Ridge power plant, where the firing is done by hand. Many tests were conducted to determine, not the greatest amount of coal or ashes that could be handled by a man in an hour or a day, but the amount that he could handle regularly, without fatigue. In addition the proper weight and shape of tools, the correct amount of material to be lifted each time, the least tiring motions, the time required for each operation and the frequency of operations was determined.
>
> As soon as the best methods and equipment were determined, written instructions were prepared covering the practice that had been found to produce the best results, and the proper tools were provided. Instruments were installed that enabled each man to see that proper conditions were maintained.
>
> Then came the most difficult part of the task—the careful and patient drilling of each man in the correct performance of his task so that the same results would be secured the same way each time. The success of such training depends to so great an extent upon the willingness and the sustained interest of the worker that some plan had to be adopted for insuring this interest and coöperation. It was therefore decided to give each man a bonus every day that he carried out the written instructions and attained or exceeded the results that should follow the fulfillment of the prescribed methods. The success of the plan is most gratifying, for not only has the company saved expense, but the workers have reaped benefits in higher wages and better physical condition after the day's work.
>
> The results obtained during ten average days at the Warrior Ridge plant under the system that has been described are shown in the following table:

RESULTS OF OPERATION FOR TEN AVERAGE DAYS

	Three Boilers
Heating surface, square feet	6,000
Horsepower, manufacturers' rating	600
Horsepower developed	1,150
Horsepower developed above rating per cent	91.8
Maximum horsepower developed 15 min. peak, per cent	150
Temperature of escaping gases, F°	490
Temperature of superheated steam, F°	505
CO_2 (approximate), per cent	10.5
Apparent evaporation, lb.	8.007
Factor of evaporation	[illegible]
Equivalent evaporation, lb.	10.714
Efficiency of boilers and grate	72.5
Steam per kw.-hour, lb.	22.27
Coal per kw.-hour, lb.	2.5
All-over efficiency, per cent	9.5
Cost per 1,000 lbs. of steam, dollars	0.0823
Cost per kw.-hour of coal, dollars	0.00221
Average daily load factor, per cent	67.3
Pounds of coal banking per 1,000 square foot heating surface, per hour	26.3
Coal used, kind	Broad Top
Fixed carbon, per cent	[illegible]
Volatile, per cent	15.95
Ash, per cent	6.03
Moisture, per cent	1.20
Heat value, B.t.u.	[illegible]

> The success of the system in use in our power plant is dependent upon a spirit of coöperation between the management and the workmen. The management is [illegible] accept its proper share of the responsibility and [illegible] in touch with the latest developments of boiler room [illegible]. If such suggestions are adopted an effort is made to [illegible] credit to the originator of the idea. The workman's responsibility begins as soon as the standard has been established and is placed in proper form before him by the [illegible]

Still another example of what this method can accomplish, even in unusually well-managed plants, was recently reported by Mr. G. E. Williamson at the eleventh meeting of The Technical Association of the Paper and Pulp Industry. The boiler plants referred to were operated before the work was started at an efficiency averaging 67 per cent. due to the strict attention to operating methods. Yet, he said:

> Our old methods, although a considerable advance over those existing in the majority of paper and pulp mill power plants, did not prove entirely sufficient, as we realized that the maximum possible efficiency was not being obtained. The results easily shown in tests did not remain as every-day performance, and the interest and enthusiasm aroused in the firemen at these times soon disappeared and with them the high evaporation and efficiency.
>
> It was then necessary to run a large number of boiler tests with different conditions of draft, forced draft pressure, thickness of fires, rate of combustion, flue gas temperature, coal mixtures, etc., before we were at all certain. It was necessary to run some 30-odd boiler tests before we were at all certain that variable conditions are accounted for, and that we really know how to adjust the condition in order to secure the maximum efficiency at any rate of driving. Following these study tests, we ran a number of check tests to ascertain beyond doubt the possibility of attaining the predetermined results at will.
>
> Once all prescribed conditions are fulfilled, the efficiency of 74 per cent or better necessarily follow. (See Fig. 26.)
>
> . . . . as the work progressed, it became a very important task of our supervisor to train the men to improve first one condition after another, until the everyday results obtained were comparable with those obtained under favorable test conditions.
>
> The next step was the determination of a suitable bonus for accomplishing the standard task. Men realize full well that if they save coal their service becomes more valuable to the company, hence they expect corresponding additional compensation or bonus[7].

What is probably of still greater importance is the clear realization that "The responsibility for inefficiency, waste of coal, loss of power, misuse of supplies, breakdowns, and interruptions to service falls on the management for it is plainly due to their neglect in some one of the following respects:

1. Failure to devise efficient methods.
2. Failure to teach men good habits.
3. Neglect to provide men with necessary instruments and incentive.
4. Indifference to planning the work ahead.
5. Faulty organization of auxiliary service.
6. Improper selection, care and issue of materials.
7. Thoughtless distribution of load through the day, week and year.

Here is a statement appearing in the employees' publication of this paper company which bears witness:

> A. F. Graves in the November, 1917, issue of ***Strathmorean***, "We find that a saving of 12 per cent has been made in fuel. This does not mean that 12 per cent less steam was generated, but it does mean that for the same amount of steam generated one-eighth of the coal was saved.
>
> What does this mean to you and me from a patriotic point of view? Simply that this large pile of coal has been conserved for some other manufacturer to carry on his work. Some factory is making guns for our boys at the front or clothes to keep them warm with that same coal.

The late Dr. R. H. Thurston made a statement which we all should remember:

> Our present common wage system must inevitably be im- [illegible] if we are to avoid very [illegible] have been [illegible] growing more [illegible] will surely come [illegible] the result of the efforts [illegible] in the immediate future.

[illegible] experience with task work with bonus as applied in the power industry gives us some reason to believe that we are at least one step nearer to the solution of [illegible] the greatest of social problems.

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[6] See *Transactions* American Society of Mechanical Engineers, 1913, paper No. [illegible]

[7] [illegible]

Evolutionary Business Principles

Lay the Basis for Determining the Proper Cost of a Commodity With Reference to the Rights of the Public

By L. P. Alford

Editor Industrial Management

The United States Federal Trade Commission has been hearing testimony to assist in determining and fixing reasonable maximum prices and terms of contract for the sale of news print paper. Mr. H. L. Gantt and Mr. C. E. Knoeppel, testifying on behalf of the newspaper publishers, declared a group of principles that will have a profound effect upon the conduct of business once they are generally applied. Every reader will find much to consider and study in these principles as they are given in the following brief report.

READERS of INDUSTRIAL MANAGEMENT are acquainted with the hearings that have been in progress in Washington before the United States Federal Commission to assist that body in fixing the maximum prices and the terms of contract, to become effective from April 1, 1918, for the sale of news print paper. These prices are to continue for the period of the war and for three months thereafter, with the right that any of the manufacturers who are party to the agreement, or the Department of Justice of the United States, can ask for a further investigation to determine new prices or new terms of contract whenever conditions arise which in the opinion of either make it desirable or necessary to ask for a change. The paper manufacturers have asked for a price which the publishers contend is too high considering the cost of manufacture as it is to-day.

In general, the accountants of the interested parties have agreed as to the proper methods of distributing various items of direct manufacturing cost, labor, material and factory overhead, and have further agreed to set up separately selling and general administration expenses. But there is considerable difference of opinion as to the fundamental principles to be applied in regard to a number of important items.

The hearings in which these principles were presented and developed opened on Monday, May 6th. The first two witnesses for the publishers were Mr. C. E. Knoeppel and Mr. H. L. Gantt, who are well known to INDUSTRIAL MANAGEMENT readers. It is not my purpose to deal here at any length with the testimony itself, but during the first two days basic principles were declared that deserve to be characterized as "evolutionary."

They are evolutionary, not so much from the view-point that they will at once overturn present business methods and practice as regards the determination of the cost of commodities, as in their possibility of tremendously modifying our manufacturing methods, process and management in order to obtain proper costs with reference to the rights of the public at large. The principles are of such importance that no industrial executive can afford to pass them by without a most careful study.

THE FIVE PRINCIPAL ISSUES

Before presenting these principles it is wise to give the five principal issues as they were developed at the opening of the hearing:

1. Whether in all industrial rate-making cases the rate should be fixed with relation to the replacement value new as of the time the rate was to be fixed, or in accordance with the investment.

2. Whether in figuring the cost of the manufactured product the raw material is to be charged at the actual cost to the manufacturer, or at its market value.

3. Whether in calculating costs the manufacturer should add a profit to each operation, or simply charge the labor and expense needed to perform that operation.

4. Whether in establishing cost of power the valuation of the site should be made on its value as a sales consideration, including the undeveloped power, or be taken as the actual cost of the developed portion needed for the operation.

5. Whether the manufacturers should expect to be allowed for a capitalization against their timber properties beyond the actual amount that they have spent for acquiring, maintaining and improving such property.

The first of these issues plainly puts the question as to whether or not it is right to include in the investment value the appreciated value of industrial property, for there may have been a tremendous increase by the addition of unearned increment. The second concerns raw material and asks whether material shall be charged at what it costs or at what it is worth in the open market after it may have tremendously increased in price. The importance of these two questions is brought home to us to-day by the mounting prices of all the materials of manufacture, and the greatly increased cost of plant construction and equipment as compared with the prewar period.

The third query concerns the method of adding a profit and calculating costs. It is evident that its answer must clearly differentiate between costs and selling price.

The last two issues concern the cost of power and capitalization of timber properties and are, therefore, rather more specific than general, although the principles developed in their reply apply to industry broadly, as will be quite evident to the reader.

MR. C. E. KNOEPPEL'S PRINCIPLES

Mr. C. E. Knoeppel was the first witness examined, and in his testimony stated ten principles, as follows:

Principle No. 1.—Valuations. In valuing industrial properties, the true measure is the investment value, the investment value being the amounts that are actually expended in building and equipping the property and providing for working capital; that where possible and proper records are maintained, as to capital accounts, depreciation and maintenance, the original cost of the plant and equipment should be used, as a basis for determining the capital value of the property; this original cost, less depreciation reserve, furnishing the present worth; but where such records are not maintained, then the property should be made the subject of a careful appraisal, in which the values determined shall be as close as possible to those obtaining, during the period of the properties' most intensive development. This appraisal is thus indispensable.

Principle No. 2—Material Costs. Materials should go into costs of operation at the exact amount expended for the particular items concerned. This would bring the finished product to the ultimate consumer, at the least cost of production. At the same time, this method affords the best possible basis upon which the concern in question may determine a fair return on its investment. If there is to be any intermediate profits, through the difference between cost and market prices, it will be seen that such a practice would react against itself, because such a method must inevitably accrue to the disadvantage of the producer, by making his product cost more than the consumer would be willing to pay, or more than a similar article would cost, under a more careful and scientifically considered procedure.

Principle No. 3—Utility of an Investment. If, for economic reasons, an investment is made in a utility, which can only be used for part of the time, in doing that for which it was created, or part of the utility, for all of the time, then all of the amounts expended in creating that utility, and putting it into operation—the investment, in other words—are assessible, through depreciation reserves, against that portion of the time all of the utility is in actual operation, or the proportionate part of the utility used all of the time.

Principle No. 4—Possible Capacity vs. Employed Capacity. The proportion of overhead expenses or "burden," in a department of a business to assess against the production of that department, varies in the ratio of the capacity actually employed on production, to the possible capacity that could be employed, under normal conditions, the difference to be carried monthly, into a departmental "burden adjustment account," and closed into "profit and loss," at the end of the year.

Principle No. 5—Standard Operation Costs. To place the burden of inefficiency and waste, on the shoulders of those who produce it or are responsible for that condition, so as not to include it in prices paid by the consumer, costs of operation should be predetermined, on the basis of practical standards, within the attainment of workmen, machine, department or plant. Any difference between the actual costs, and the standardization costs, should be carried monthly into a departmental "cost adjustment account," and closed into "profit and loss," at the end of the year.

Principle No. 6—Interest on Investment. Costs of operation should not have included in them any charge covering interest on investment, as this would serve to anticipate earnings, through including a profit before it was made. No profits can be made in a business until products are sold. What is actually put into a business is the investment. What is actually earned, is in the interest or return on the investment.

Principle No. 7—Interest on Borrowed Money. Interest on borrowed money should not be made a charge against costs of operation, as borrowed money, from the viewpoint of operation, is equivalent to capital invested. An industrial with sufficient capital to build, equip and provide working funds, should pay the returns on the investment out of the profits. Borrowed money indicates insufficient capital invested, making it necessary to bring in additional funds, and the interest charge should likewise come out of the profits.

Principle No. 8—Depreciation. Provision should be made, through costs of operation, to maintain the book or going value of an item of investment on a level with the diminishing value of the item, due to its usage or other reasons. In other words, production must absorb all capital investments, in the course of time, in proportion to the use of this investment, making the production possible, and return to the business the initial expenditure.

Principle No. 9—Basis of Fair Return to Investor. The actual capital investment of an enterprise, as defined in Principle No. 1, constitutes the true basis, on which to determine a return to the investor. As selling prices, which should include the return on the investment, are based on costs of operation it follows that cost is the element which should be used, in calculating returns.

Principle No. 10—Rate of Fair Return. The rate of return, on actual capital investment, is less dependent upon the hazards, speculative character, difficulty in inducing capital to invest and the nature of the business, than it is on the relation between a safe and sure return, and a possible but unguaranteed return. Assuming that 4 per cent. is a fair return on a guaranteed investment, like bonds and mortgages, a return to an investor in an industrial can be said to reconcile the difference between the two classes of investment, if the rate is two and one-half to three times the guaranteed rate, or to put it another way, 5 to 6 per cent. to the investor, and 5 to 6 per cent. to the business, with which to build up a surplus, this to apply to the successful, efficient and well managed concern, as an average over a long period of years.

MR. H. L. GANTT'S PRINCIPLES

Mr. H. L. Gantt presented the following five conclusions which may be taken as directly corresponding to the five issues above:

1. The value used in figuring expense rates should be based on the investment.

2. The material used in the manufacture of a commodity must be figured at its actual cost, including the expense incurred in having it ready for use when wanted.

3. The cost of the article or commodity should include only the actual labor, material and expense necessary for its manufacture, and should not include a profit through the various steps of manufacture

4. The expense of power should be charged into manufacture at its actual cost, this cost being based on the actual investment needed to produce the power used.

5. The manufacturer should be allowed for the timber properties the original expense plus that of maintenance and improvement.

RIGHTS OF THE PUBLIC IN MANUFACTURING COSTS

The thought of the over-shadowing rights of the public run through all of these principles. Each one of us has a vital, personal interest in the way our manufacturing plants are run. Idleness and inefficiency must be eliminated. If a factory does not give the public anything worthwhile, why should the public pay anything for its product? If a manufacturing concern cannot produce goods at the standard cost why should it produce at all? Why should we pay forever, and continue to pay forever, through the increased cost of articles, for mistakes, failures and mismanagement in manufacturing and business?

A critical attitude by both manufacturers and the public toward these facts and questions will be a tremendous spur to more efficient production.

While the dragon of the Rhine has the power to menace the freedom of the world, the greatest cross of honor among free men will not be that of any military decoration for valor, but the rude wooden cross in the Flanders [illegible] H. Simonds.

Vestibule Schools for the Unskilled

How to Overcome the Shortage of Skilled Mechanics

By H. E. Miles

Hundreds of thousands of unskilled men and women have passed through the training schools of England and France into the munition factories that are producing the war material that the Allies are using in this year's great battles. A few such schools are now operating in the United States. But many more must be established, for it is estimated that 1,500,000 persons must be trained immediately for our war production. Mr. Miles shows how such schools should be organized and gives some amazing results from those already in operation.

Mr. H. E. Miles *has been a manufacturer all his life, having occupied every manufacturing position from factory superintendent to director of sales, financial, executive and owner of the Racine Wagon & Carriage Company. He entered this firm in 1884, when it was a small concern making 1,900 vehicles per year. He developed it into one of the four largest and most successful establishments of its kind in the country, finally having a production of 3,500 vehicles per month. When the automobile began to replace the carriage he sold out his interests; for the past six or eight years he has specialized on the training of working people and has been Chairman of the Committee on Industrial Education of the National Association of Manufacturers. From the inception of the vocational education movement in Wisconsin he was president of its State Board until about a year ago when he accepted the chairmanship of the Section on Industrial Training of the Council of National Defense. Few men, if any, can speak with more authority on matters of industrial training and from such richness of experience.*

THIS war is a war of machines and machinists. The four great manufacturing nations of the world: Germany on the one side, with her allies; England, France, and now the United States, on the other, are making this war one of character, of genius, of endurance, but all expressed primarily in terms of the machine and the man behind the machine. In the end it will be the last ounce of machine power and of man power behind the machine that will decide. Long ago man power came in the other countries to mean both man and woman power.

It is useless for us to discuss whether or not, at this moment, we have enough workers. The question is this: have we an abundance of extremely efficient, trained machinists?

We know that we have not.

President Wilson has said, "Our efficiency every way must be greater than ever before." We know that in our shops to-day it is lower than we can ever before remember.

Since August, 1914, we have been in a new industrial world and unfortunate indeed is that manufacturer whose methods are not those of 1918. Many an employer is complaining about his workers when the fault is his not theirs, for he has failed in his essential duty of training them and fitting them for their duties. Training employees reduces labor turnover, lessens slacking and tends to prevent stalling — but the real remedy for the latter evil is never to cut a piece price unless the process is changed.

We are partners with England, France and Italy. We must go in the direction they have gone. In the first year of the war they exhausted their supply of skilled man-power, as we have done. They had no alternative but the one we now have. They made the unskilled skilled, and upgraded the semi-skilled to tool-room and precision work.

By the end of the second year of the war they had used every man for work that only men could do, and began to train millions of women for men's work in machine shops and elsewhere, which work, partly because the women were better introduced and trained to the new tasks than men had ever been, they often did better than men had done, both in quantity and quality, with less waste of material and less loss of time from sickness and otherwise.

Older methods of training "on the job," that answered in a poor sort of way with an old-time labor turnover, failed utterly in war time. For the simplest operations, however, instruction could still be given on the machine Also, as in peace times, for some operations picked operatives were delegated in the proportion of 1 to 4 or more, to supervise and instruct at the machines. But, for the most needed and successful upgrading of the production forces, rooms in the factories were set apart. Typical machines were installed, and the new employees were there taught what they were to do in the shop.

Not only are unskilled operatives, men and women, taught to operate the machine he or she is to use in the shop, and given wages from the first, but in from one to two months of continued instruction, always upon production, men and women have been taught to do precision work to limits of 0.0005 of an inch, to make tools, dies, templets, etc.

QUICKNESS IN LEARNING REMARKABLE

The quickness with which these new people learn when they are well selected for their tasks, is remarkable. The production engineer of one of our greatest war industries saw an inexperienced worker on a turret lathe, making precision cuts on a brass piece for an optical sight for a battleship in an American factory training room. Other new employees were looking on, soon to take their turn. Said the visitor to this new operator, "You must be the teacher." "How long have you been here?" "I came yesterday," was the reply.

One half billion dollars' worth of war orders have recently been placed in Detroit which will require 45,000 additional machinists, of whom there is already a shortage. This seemed to require the employment of women by one of the largest makers of Liberty motors, so he advertised for 300 women of high moral character, no previous industrial experience required, preferably 20 to 35 years of age, *with relatives at the front.* Sixteen hundred immediately applied. One must see the remarkable speed, earnestness and accuracy of these women in the training-room and in the shop to believe it.

President Wilson has said, "The supreme test of the nation has come. We must all speak, act and serve together."

It is in this spirit that the representatives of organized labor and representatives of many of the largest manufacturers in America are serving together in the Section of Industrial Training of the Advisory Commission of the Council of National Defense. It is in this spirit that Mr. Samuel Gompers as chairman of the Committee on Labor, invited large representative employers to membership in this section in equal numbers with the representatives of organized labor and specialists in industrial and shop training. It was in this same spirit that manufacturers accepted his invitation.

In this spirit it is agreed by everyone that the proposed training shall never be used for other than the highest ends, that labor shall be upgraded as far as possible, that no worthy working man shall be left unemployed and the place he might fill given to one from an outside industry, be it man or woman.

EXPERIENCE OF ENGLAND

At first England mussed along as we are now doing. Her employers put new workers on to machines, only to find that the newcomers swamped the old. Then they selected skilled operatives and sent them among the unexperienced to try to teach them; but there were not enough men capable of instructing. Teaching ability is rather hard to find, and usually old time teachers won't do.

Then the technical schools were resorted to. But they were too abstract and academic to meet production requirements, and at first the results were negligible. Then came the replacing of the school directors by factory managers with shop foremen in charge of the school departments. As a result of this move all sorts of persons were successfully trained for industry; salesmen, men and women without occupations, men from non-essential trades, and the like. In from one to three months they became proficient in highly skilled operations, often on such precision work as gage making and the turning out of jigs and fixtures. Qualitatively the results were good, but quantitatively they were small. The number of persons now trained in this way averages only about 1700 monthly. After all, the final opinion of this training seems to be that it is more academic than necessary.

The next step in the British solution of this training problem was the setting up of five instructional factories. Two were in London, and one each in Birmingham, Manchester and Dublin. These centers of instruction have been particularly helpful, especially in training highly efficient workers to lead in developing new workers in the factories. But their principal object is the training of instructors and especially proficient operatives. Again their capacity is comparatively limited, as they can accommodate only 800 persons at a time, each course lasting for six weeks.

In time British manufacturers came to see that one of their grave responsibilities in the production of war material was a systematic training of mechanics. None of the means previously employed was in any degree adequate to satisfy the demands. It came to be realized that just as a factory has a tool-room to provide its special tools and equipment, so each plant must have its training-room where would-be employees, the human means of production, can be made thoroughly fit before they are set at work. England would have lost the war long ago had she not scientifically developed her labor power. So after a time the British Minister of Munitions virtually compelled all munition producers to train their own machinists. Some of the results are astonishing, as witness this excerpt from a report of November, 1916:

Allocation, Production	Firm No. 1.	Firm No. 2.	
Skilled males	8	82	
Semi-skilled males	70	1,200	(including forge and cutting off)
Unskilled males	0	0	
Women	495	0	
Toolroom			
Skilled males	2	26	
Semi-skilled males	1	0	
Unskilled males or women	12	0	
Total	588	1,308	
	3,500 6-inch shells	3,000	6-inch shells
		2,300	5-inch shells
		120	5.5-inch shells

The wonder of this statement is, however, that Firm No. 1 produces 80 per cent. more per operative than Firm No. 2. The British Ministry emphasizes this in an effort to freshen the minds of managers as well as workers. And notice the small per cent. of all-round toolmakers in the toolroom of Firm No. 1. Wake up Mr. Employer. Upgrade willing understudies.

EXPERIENCE OF FRANCE

More than a year ago the French Ministry of Munitions appointed a commission to investigate the French methods of training, and upon the report of that commission the government requires every factory employing 300 operators or more to have a room, preferably near its tool-room, for the upgrading of its employees. The smaller factories are excused only if they make arrangements with public and other training schools for systematically training their workers.

SUCCESSFUL RESULTS IN THE UNITED STATES

For years we have had apprentice schools and industrial training schools in connection with some of our most successful manufacturing plants. But it is only recently that training rooms or vestibule schools have been introduced. One that has produced noteworthy results was described in the May issue of INDUSTRIAL MANAGEMENT by Mr. C. U. Carpenter.

The Lincoln Motors Company of Detroit, Michigan, recently took on 300 women, sending them through the training room before they entered the factory at all. The Curtis Airplane Company, Buffalo, New York, has set aside a balcony of the shop, 600 feet long by 50 feet wide, and is passing through this training-room unskilled men and women at the rate of 30 a day. A government inspector states that after four days' training previously unskilled girls were doing the best cable splicing that he had ever seen; their average output as compared with the old operators was in proportion of 55 to 40. On another operation the time required in the training-room was 48 minutes, as compared with 60 in the shop.

Here is a bit of experience that is unusually significant. An American manufacturing firm using [illegible] of recruiting workers had a labor turnover of 10,000 in a force of 15,000. It sent employment agents over the country from the Atlantic seaboard to the Mississippi River. The cost of securing each worker was at least $50. It is now proceeding to train, to "upgrade" 1000 men from simpler processes, and to fill the places thus made vacant it is recruiting women, particularly those whose relatives are at the front.

The gross cost of this training is $3 per worker, against which charge there are many small credits that should be set off. Contrast this with the estimate of $75 to $150, the former cost of "breaking in" new workers under the old methods.

Labor Slacking and Stalling

Many employers have charged labor unionism with the whole responsibility for the limitation of output, when the cause as well as the remedy is probably in the hands of the management itself.

Stalling is common, even in the large, well managed, open shops. Note these instances: In one representative factory a few newly trained workers were sent recently into a department where output had averaged 150 pieces per operator per day. Immediately the old workers produced 300 pieces each. In another factory a woman on her third day at the machine made $9. She did this because she was given the same rate as the man before her, who has satisfied the company for a long time with a $5 output. In another factory with enormous war orders, newly trained men entered the shop only to report back that they could not deliver full production because of the opposition of old employees.

Much of this stalling is due to the workers' knowledge that if they produce more their rates will be cut. So may we not wonder if the evil will not be substantially cured if employers will make rates with extreme intelligence, as a few now do, and never cut a rate unless there is a change in the process.

A certain wise employer sets his piece prices or base rates not only with great intelligence, but with some liberality. Consequently he shares prosperity with his workers by paying wages so high as to provoke the enmity of his competitors, and yet his unit costs are so low that the government experts say that they are the lowest in the market. And his output per worker astonishes every one.

A Dual Obligation

My final message is to emphasize a dual obligation. The representatives of labor and all wage earners are called upon to give unstinted production within the full bounds of health and safety. All employers are called upon to set wage rates with the utmost intelligence, train their workers for the duties required of them, assist the workers through continued proper instruction so that they will reach the production necessary—and then never cut a rate until a change has been made in the process.

Labor turnover is often reaching 5 to 10 per cent. per week instead of per month or year as formerly. A host of men who might readily be made serviceable are wandering from shop to shop, and town to town, while as a result, production lags.

Employers, will you advise yourselves and help? Buffalo employers have decided to train their own people and to stop preying upon one another and upon neighboring cities. So of Rochester, Dayton, New Haven, Bethlehem, Waterbury, Detroit, and many places in New Jersey and elsewhere.

Places of employment must be training places for the making of mechanics and machine operators.

This statement is too brief to more than touch upon the subject. The Section on Industrial Training for the War Emergency, Washington, D. C., or through its branch committees, is preparing to give extensive information and suggestions. This section is the only governmental or semi-governmental agency devoted to this purpose.

The Employees' Benefit Association—VI

Should Side Issues Be Included? How Can We Measure Results?

By W. L. Chandler

This final installment of Mr. Chandler's *helpful series on the many troublesome questions in regard to the establishing and operating of an employees' benefit association takes up nine questions. These are summary in their nature and deal primarily with the means of obtaining and measuring adequate results.*

Mr. W. L. Chandler *has been identified with many national movements. He recently called a National Catalog Conference at which size standards for catalogs, paper sizes, weights and colors were adopted which will effect very wide economies in the paper and printing industries so important at this time.*

THE employer carries the burden of the overhead of an employees' benefit association and should have as its secretary a man of considerable intelligence—a man capable of creating good will for the association and for him.

This same man, by virtue of his contact with the employees, is in a splendid position to supervise other activities which are intended to serve both employee and employer. The employees managing the association and the official of the company who serves as actuary are usually of the type which takes an interest in those movements intended for the general well being of the masses.

Such a group of men is usually capable of looking after more of the same class of work. Consequently other activities may readily be taken on as side lines.

Another great advantage of this linking together of the benefit association, the thrift club, the building and loan, and some other similar activities lies in the fact that these financial bodies in which employees invest their money are thus supervised by fellow employees.

Employees are so often doubtful about leaving their money with the employer. The employer who needs the use of the money of his employees is in such financial shape that it would be a crime to use it, and the employer who does not need it will make a hit with the men if he avoids handling it. He should confine his efforts to advice which is evidently unselfish and of the most constructive type to really benefit his employees.

Problem Number 62

How Shall Sick Members Be Located?

The easiest way to ascertain when absent employees are sick is to consult other employees living nearby. Divide the city into districts and cross index members by the district they live in.

Then as soon as a man is absent, inquire of other employees living near him to learn if they know why he is off. This plan will save many trips of the nurse or others to look up employees who are off through causes other than sickness or accident, and further will show the well employees that the association is looking after the sick, which helps build up good will.

When sickness is thus discovered early, various opportunities may be utilized to minimize the seriousness of the case with resulting benefit to the membership.

Problem Number 63

What Are the Advantages of Social Features?

Does it pay to bother with employees, clubs, savings and loans plans, rest rooms, safety-first propaganda, or any other welfare, service or fellowship work?

It depends upon how you want to receive the pay. Some employers have developed fads along these lines; others are capitalizing their efforts through the advertising departments; others are doing certain things which insurance inspectors have suggested as a means to lower fire or compensation insurance rates; others feel that these things keep the officials closer to the men than can be accomplished in the present day corporation in any other way.

Other executives realize that at best the every day grind of an employee's life in a factory is apt to become monotonous and lead to discontent unless some leaven can be injected into it, and welcome these things as a means to help reduce the labor turnover and discontent.

A few feel that they want to make the world a better place to live in, and use these methods in accomplishing that end.

No matter what the motive, the net result for the employee is beneficial, provided the work is handled with the proper care and business judgment.

In some cases an employees' club is a splendid thing and in others it may not be of any value. In any case, it will not run itself. It needs a stimulator all the time. If the entertainments are sufficiently popular to interest a large percentage of employees, the attendance and enthusiasm will be very gratifying.

A "high-brow" club will seldom meet with much success. To succeed, a club must appeal to "low-brows," "high-low-brows" and "low-high-brows," with a chance for a "high-brow" now and then.

No single form of entertainment will interest all classes of members. Bowling, gymnasium, billiards, cards, vaudeville (home talent or otherwise), concerts, smokers, lectures, boxing, baseball, indoor ball, etc., with something doing every week will create enthusiasm with little effort necessary to increase membership. If the club supplies a demand either natural or inspired by the bulletins, the membership will grow rapidly just as the membership of the association will respond to sales efforts, as has been demonstrated.

Problem Number 64

What Savings Plans Are Wise?

Very few people of any station in life know how to save money systematically and yet the acquisition of that habit will do as much as any one thing to make a man contented.

When the savings plan was first tried by the Dodge Relief Association it was with caution that many of the men were approached. The proposition which was laid before some of the men was that they might add to their dues any multiple of 25 cents each week to be set aside as part of a savings fund not to draw any interest and not to be drawn out in less than 14 weeks except in emergencies. Each man in the plant who was suspected or known to be improvident was approached personally by the secretary.

No effort was made to reach the men who already had savings accounts or were paying for their homes, etc.

The improvident fellows may be represented by one who said he never could save a cent because it cost him more to live now than he could earn and it would be silly to take any more out of his pay envelope.

The secretary explained that he surely could stand 25 cents every week without missing it, and that he was wanted for the sake of his name. He (the secretary) wanted to tell others who were not so well posted in such matters that this man had joined the movement. Most of these fellows, under this method of treatment, joined, and usually with their own prediction that they would not continue for long.

Inside of six weeks nearly all of the improvident fellows had voluntarily doubled the amount on the grounds that they had not missed the money. This came about through suggestive remarks of the secretary who is always in touch with all members.

Before the 14 weeks were up, many of these same fellows were saving \$2 to \$4 every week. The secretary made it a point to see each man before his 14 weeks were up to see what his plans were. Some left the amount in and continued, others withdrew the balance and continued, but almost none of these fellows quit the savings plan while in the employ of the company.

One fellow was asked if he was going to have a high old time now that he had a few dollars coming to him as easy money. He replied, "I am going to have something I never had before in my life, and that is a bank account."

One man saved enough to buy a Ford car, others save for taxes, coal, insurance, clothing, etc.

Men have been taken out of the hands of loan sharks and taught how to save, but most of them have not yet reached the point aimed at, where they can take the pay envelope down to the bank and put some of it away. It is still necessary to deduct it from wages in most of the cases.

However, it is interesting to see the saving spirit developing in them. Once acquired, the habit ought to be permanent.

This experiment was tried to learn how much could be accomplished without paying interest. Now four per cent. interest is paid each six months through the coöperation of one of the banks. The total weekly savings doubled as soon as this plan was adopted largely due to the stimulating influence of this inducement.

Why should an employer take any interest in the savings of his men? Because a man in debt is never happy, is always underpaid in his estimation, and invariably carries a grouch.

Teach him to live within his means and you have made him fit to be trusted to handle your property as a foreman or executive provided he has other necessary qualifications. Would you trust a man as a foreman who could not administer his own pay successfully?

I have encountered a very few hopeless cases, but on the whole I never derived any more joy from any prolonged effort than I have from hearing the inspiring stories told by large numbers of men who have caught the spirit of saving.

They are much less wasteful in all their work. The record of spoiled work in the factory will tell the story.

Problem Number 65

Can a Benefit Association Expect to Reach Results As Favorable As the Average Quoted Herein?

Surely, yes! Some results were so very poor that the average, thus being low, should be easy to exceed if one will make up his mind to do it, and will adopt approved methods in the conduct of the affairs of the association. The business of the association calls for executive ability just as any business does. The employer should see that the necessary executive ability is supplied.

The remarks of Dr. Steinmetz in Problem Number 1[1], suggest the need of an executive who appreciates the viewpoint of the mass of employees (the collectivistic type).

All executives should comprehend the typical viewpoint, but it is doubly important in the case of those entering into the problem of human relations with employees that they do so.

Hence great care should be exercised in selecting the guiding counsel of the association.

Problem Number 66

Why Is a Large Percentage of Membership Desirable?

The average or typical individual does not voluntarily buy insurance of this sort. It must be sold to him. Desire, an important element of a sale, may be created by sales methods or may come from indigestion or other ailments. Ailments affecting the anatomy below the belt are especially apt to lead to membership. On the other hand, the employees who normally enjoy better health, and are therefore, better risks, must be brought up to the stage of desiring membership by sales methods.

A high percentage of membership to number of employees affords the best opportunity for favorable average experience.

Chart 14 in April Industrial Management shows how membership was trebled by the use of sales methods. Chart 15 in the same issue shows that when the sales methods were adopted, 15½ per cent. of the membership was between 41 and 45 years of age. That represented the largest age group although groups of higher ages were too prominent at that time. About one year later the largest group was of ages 21 to 25, while all groups over 35 years had shrunk satisfactorily.

This improvement came about not by the old members dropping out, but by the influx of young blood.

Chart 26 shows that the best part of the influx occurred in the last half of the year.

Chart 27 shows the advantages gained during the year in that the cost of disability per member fell off more than one-third. This was due mainly to the fact that the membership was more representative.

Chart 28 reflects the same conditions. The percentage of members receiving benefits fell off very satisfactorily. This took place before preventive efforts had made much headway. Therefore, it too is probably due largely to the fact that the membership was more representative.

Chart 29 shows some improvement in the average amount of money paid out to members requiring aid. This, however, shows less improvement than the general average per member. In other words, the separate cases of disability were no less severe than previously, but there were fewer of them. Hence, he may conclude that the improvement in the general average, was influenced mainly by the addition of considerable numbers of new members normally of better health.

Problem Number 67

Should We Offer Inducements to Secure Favorable Results?

It should not be necessary to urge men to provide the safeguards which are so greatly needed by them, but the fact remains that it is necessary if we are to secure the greatest good for all members, and indirectly for the employer.

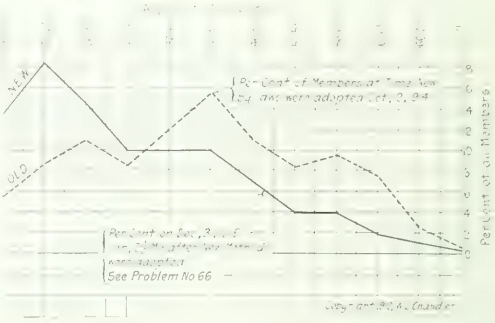

Chart 26

Problem Number 70 suggests several bonus plans for securing a big membership. In addition to these, something may well be done to induce a favorable record on disability, and thus indirectly on death.

As a means to this end, I suggest prizes for the departments making the most favorable showing. I should say two weeks' dues for each member in the department making the best record on disability for a given quarter of the year, with one weeks' dues as second prize. Prizes to be paid by the employer.

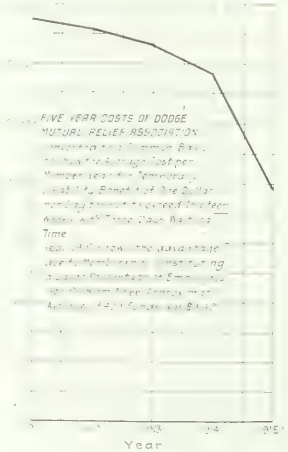

Chart 27

The disability record may be compiled in various ways, but it seems to me that the proper method would be to convert the benefits paid out onto the basis of $1 a day, and then make a comparison on the basis of percentage of disability dollars to revenue. My idea is always to bring these bonuses and everything else that is proposed into such shape that each and every member can readily visualize it.

These suggestions will, if adopted, result in an automatic reduction in malingering, because, while a member might fool the secretary, or even the doctor, by being in bed when visits were due, or otherwise, he could not very well fool the whole neighborhood for any considerable time.

Problem Number 68

How Should Results Be Measured?

The success of an association may be measured in three ways: By the percentage of members to those eligible for membership; by the amount returned to members per year plus the amount put into reserves for each dollar collected as dues; and by a comparison with other associations as to the claims paid and other experience.

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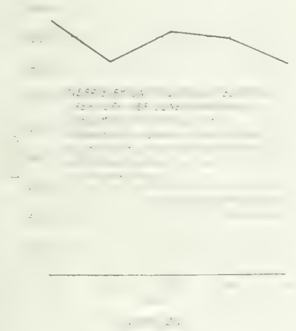
[1] Industrial Management, January, 1918, page 34.

The results shoud be scrutinized throughout the year the same as in any other business, but when the annual report is received, it should be studied carefully by the actuary to make sure that the association is maintaining a proper degree of efficiency, for, like any other business undertaking, it will slide backward unless continually pushed forward. A tree either grows or dies.

CHART 28

Of 461 associations, the general membership average was 48 per cent. of the eligible employees. Of these managed solely by the employees, the average was 30 per cent., one being as low as 2½ per cent.; of those under joint management of the establishment and employees, 66 per cent. were enrolled; and where the management rested solely with the establishment, 75 per cent. enrolled.

Many associations had memberships of between 60 and 95 per cent. without resorting to compulsion, while some were compulsory. To be really effective the membership should be voluntary and at least up to 80 per cent.



The percentage of membership is a good index to progress. In problem Number 70 are presented some methods for boosting memberships.

The degree of economy exercised by the management, as well as the general efficiency of the association, are reflected in the amount of benefits, dividends, etc., returned to members per dollar taken in dues. See Chart 3 in the February issue of INDUSTRIAL MANAGEMENT. Income from entertainments, bazaars, etc., makes possible a very fine showing on this score.

Information given with other problems will be of interest in this connection.

To borrow an insurance term, the "loss ratio" is an indicator of many things. The first and most important function of an association is to keep the members well and at work.

The average loss ratio of all associations is a fair indicator of what may be expected by any one. The successful association is the one ahead of the average; the farther ahead, the more successful the organization.

The loss ratio reflects the care exercised by the management in selecting members, keeping down malingering tendencies and preventing disease and accidents. See Chart 27 herewith.

The success of the association is a matter of great moment to the establishment as is shown elsewhere.

PROBLEM NUMBER 69

HOW CAN WE COMPARE NOTES WITH OTHERS?

The figures and averages given here covering in all about 600 associations were received in large part through the kindness of the Commissioner of Labor and then converted into percentages and analyzed for more ready use. Data covering some of the problems was received direct from over 100 of the associations. The greatest difficulty came through the fact that statistics were not kept on any standard plan so that some of the conclusions are of necessity arrived at by careful approximation rather than by *exact* calculations.

For the benefit of all, we should develop some standardized method of compiling statistics.

A Federation of Employees' Benefit Associations would enable those most interested to get together and agree upon standard statistical forms and many other problems might be solved at the same meetings.

The Health Service Section of the National Safety Council expects to set aside a day at its next congress to be held in St. Louis this Fall for the study of problems of the Employees' Benefit Association.

PROBLEM NUMBER 70

HOW CAN WE GET A BIG MEMBERSHIP?

An association is engaged in selling insurance and should conduct its business in a manner to sell lots of it at prices which will enable it to make good on its obligations without piling up undue profits or surplus.

From this, it naturally follows that the management cannot be left to inexperienced or indifferent people. It must be directed by some one either in an official capacity or as an advisor who has experience and business ability sufficient to sell the insurance to a large percentage of those eligible for membership at a proper price. Affairs must be conducted in a manner to render the best possible service to the membership and with a proper regard for efficiency.

In seeking a larger membership, one of the first temptations is to make membership compulsory for all employees. This will get the members, but will often, if not usually, result in other disadvantages which will be embarrassing later.

Members of a compulsory association are in because they have to be and the only interest they have is to get all they can out of it, and they have not the same pronounced desire to see the association succeed as though they were in because they wanted to be.

After an association with compulsory membership has been established, the next natural conclusion is that the management may be delegated to inexperienced people bcause the only thing to watch is malingering, dues being deducted usually from wages.

The man who favors compulsion is likely to select an association manager of corresponding compulsory tendencies. A manager with such tendencies, backed up by the fact that the members could not help themselves, would likely be, and in many cases has proven to be, very arbitrary in his administration of affairs.

This breeds an extremely bad feeling in an establishment as against a splendid one resulting from other methods. It is not permissible to print the letters I received from establishments operating compulsory associations, but while a few were conducted with a view to making members glad of being compelled to join, many exhibited more or less tendency to show members and employees "where to get off."

The employer needs the favorable impression toward the association and *towards himself*.

To secure the popular approval of members the tactics must be the same as would be used to sell other insurance to them. It is necessary to attract attention, arouse interest and create desire just as in every sales campaign. When that is accomplished, the rest is easy, and a voluntary association will have nearly as many members as one with compulsory regulations if the members can be stimulated to boost for more members.

An enthusiastic membersship will prove the biggest single asset to both association and employer, for to get that enthusiasm there must be present those features which will attract attention, arouse interest, and create desire in others.

The first essential is to provide a permanent source of stimulation which will not interfere with a free election of officers from the ranks as the membership may desire.

Some offices ordinarily will not be filled by the same man from year to year, while others are more likely to be filled by the same incumbent as long as he will serve.

The secretary is the most likely to remain in office from year to year, and is in constant contact with all members. He then is the logical stimulator and should be carefully selected for those qualifications which will increase enthusiasm and at the same time conduct the business on proper and safe lines.

Another important point is that of wise counsel in regard to the possibilities of the organization from the insurance standpoint. Where local conditions are favorable, it is desirable to appoint or elect an actuary, whose duty is to post himself on insurance matters, particularly those matters affecting the association, and devise schemes for increasing the membership as well as to counsel against unsafe methods. See problem Number 60 and Chart 14 in April INDUSTRIAL MANAGEMENT for the effect of a dividend upon membership.

An accountant would perhaps be able to serve in the capacity of actuary but preferably some official or executive of the company who is thoroughly imbued with the sales viewpoint as well as having his heart in aiding the men to get the most protection for the least money, should be selected. Not many accountants are blessed with the imaginative faculties which are necessary in a salesman, and for that reason an all-round business man is needed. He need not devote very much time to the proposition, as the details can all be worked out under his guidance, by the secretary or others.

The actuary should act without compensation, but as the secretary should be sufficiently active to devote much, if not all his time to the work, in large associations, he should receive some sort of a remuneration.

The association may not feel inclined to pay a salary in keeping with the work necessary to maintain the organization on a basis as flourishing as the interests of the establishment dictates, therefore, the establishment may well afford to permit the secretary, if he is the right man for the job, to promote the interests of the association and of the establishment, on company time.

To repeat: The one most important idea to keep uppermost in the minds of the management (Board of Directors) of an association is salesmanship. They must sell insurance on a safe basis. Let them imagine themselves in business; it will make better employees of them by showing both sides of the business game.

Deal fairly and squarely with every member and problem that comes up—no quibbling, side-stepping or sharp practice or acts *open to suspicion*. Look out for perverted minds, unduly suspicious and ever ready to ascribe selfish motives to every act of the corporation.

NEVER LOSE THE CONFIDENCE OF MEMBERS

Keep posted on competitive insurance methods, and know how they are progressing among employees eligible to join the association as well as elsewhere. Devise insurance plans or policies which will attract business, and yet be safe from an actuarial standpoint.

Exchange actuarial experiences and information with other associations, to be sure of the best condition.

This topic may be approached from any of the four directions represented by the sociologist, the insurance man, the employer and the employee, but the points mentioned should appeal to every one concerned.

BONUS PLANS

One bonus plan is in operation in several establishments whereby the employer offers to pay additional disability benefits as the percentage of membership increases. For instance, if the percentage reaches 80 per cent. of those eligible for membership, the employer will pay $1 per week as an additional disability benefit, and if the percentage reaches 90 per cent., then $2 a week.

The objection to this plan is that it is only paid to the sick members. As most members feel that they are not going to be sick, this plan may not induce all of them to work for more members.

As a modification of this plan, I believe a percentage of the dues to be paid by the employer, increasing as the membership increases, would appeal directly to each member, sick or well, and would be better than any plan such as putting cash into the treasury of the association where it would be less noticeable.

For instance: If the membership in any department reaches 80 per cent., the employer might pay one cent per week of the dues of members from that department, and if 90 per cent. enroll, the employer might pay two cents per week. In these cases the dues collected from members through the pay roll will be less than usual, making quite an inducement to get more members.

I would, however, urge one thing in a plant having departments which are in any particular degree isolated from each other. If the percentage of the whole plant applies, one department may feel that they have "worked their heads off" to get the desired members and that their efforts have been of no avail because some other department has been asleep. In other words, the thing ought to be localized so far as the lay-out of the plant might make desirable.

The difficulty in administering this plan is that the percentage of membership must be figured each week, unless a provision is made that the membership at the end of each quarter shall be used as a basis for the next quarter, or else that each member receive a refund equal to the company's contribution for the quarter.

Another objection is that the contribution of the company coming every week gets to be an old story. To keep the matter alive in the minds of the men, it ought to have teeth to it; that is, ups and downs. Along that line, I would suggest a bonus once each month, quarter or half year of some percentage of the dues; say one week's dues each quarter to be paid by the company (consequently not paid by the employees) when the membership exceeds 90 per cent. during the quarter. When such a bonus is paid, it should be announced.

Another plan for promoting the interest of employees in these associations is in force in some plants where pension plans are in use. In these plants only members of the associations are eligible for pensions. This savors of compulsion too, and is open to criticism on that score but at the same time such a plan might be satisfactory.

Economic Handling of Ashes

Suction and Steam Jet Conveyors, Bucket Carriers, Ash Cars

By Reginald Trautschold

At best ash handling is a rather difficult power plant problem and in many cases actually costs more than the handling of the coal from which the ashes come. To help managers to turn to efficient methods, the author describes the latest developments in mechanical ash handling equipment and gives approximate handling cost per ton. He also takes up more simple means, including pivoted bucket conveyors and a combination of industrial cars and a skip hoist.

Mr. Reginald Trautschold *has specialized in power-plant design, machine design and factory economies. From* 1898 *to* 1911 *he held positions of designer, superintendent of construction, chief engineer and sales manager with prominent manufacturing firms, including Sprague Electric Company, Marine Engine and Machine Company, Henry R. Worthington, Robins Conveying Belt Co. and Intercontinental Engineering Co. Since* 1911 *he has practiced as a consulting engineer.*

THE handling and disposal of ashes from furnace grates of power-house boilers presents one of the most difficult problems about the steam power house. Compared to the task of handling the coal supply and the economy which has been attained in this latter service, the handling of ashes is still an expensive and, in the majority of cases, relatively inefficient operation. Were it possible to segregate accurately all expenses contracted in the operation of a power house, a summation of those directly and indirectly chargeable to ashes would, as a rule, be found to exceed those contracted in handling the coal supply, despite the fact that several tons of coal have to be handled for each ton of ashes.

Maximum economy in the handling of ashes was probably attained in the days when plants were small, and, judged by present day standards, crudely, expensively and inefficiently operated, when all boilers were hand fired and of limited capacity, and it was the duty of the boiler man to rake out the ashes into piles about the ash-pit door, there to await shoveling into wheelbarrows by him or an assistant and trundling, when the opportunity afforded, to some convenient ash dump in the neighborhood. It was backbreaking, disagreeable work, but, as a whole, in the old days, quite satisfactory. Although such a scheme would be quite inadequate in these days of mechanical stokers, large boiler units, limited space and the necessity for getting the ashes away from the power house as rapidly as possible, nevertheless, it is probable that the scheme that actually solves the ash handling problem most economically and with the minimum liability to interruption or danger of a collapse in the system itself is very similar—with certain refinements tending to reduce the necessary amount of manual labor.

Such simple installations will be given further consideration a little later on, but first it is wise to discuss two ash handling systems which represent mechanical development during recent years. Both systems have proved exceedingly convenient in that they eliminate practically all labor and perform the task in a highly desirable way, inasmuch as no clouds of fine ashes are raised. From a mechanical point of view both systems are highly efficient, but certain failings and possibilities of danger should frankly be pointed out, not in any way to discredit the systems, but in order that factory managers may be made cognizant of the risks and thus be enabled to guard against them.

SUCTION CONVEYORS FOR HANDLING ASHES

Particularly suitable for plants of considerable size is a system for handling ashes which utilizes the rush of air through a conveyor duct, or pipe, to an elevated storage tank, where a certain degree of vacuum is maintained by means of a high speed exhaust fan. This represents the most highly developed mechanical method of accomplishing the ash handling task. The conveyor proper consists of a heavy cast-iron, or steel, pipe running before the various boilers, under the boiler room floor, and in which small intakes are located for the receipt of the ashes from each boiler. This conveyor pipe continues out to an outdoor elevated storage tank into which the ashes are sucked. The various intakes leading to the conveyor duct are kept tightly closed, excepting when the conveyor is being actually charged with ashes.

When the conveyor is to be operated, the boiler man simply rakes the ashes to the intake, then he removes the cover and the rush of air through the opening toward the partly exhausted storage tank takes the ashes with it. The ashes are transported virtually in suspension, so there is relatively little abrasion caused by the swiftly moving ashes on any straight runs of the conveyor duct.

Whenever the direction of the conveyor duct changes, however, the flying ashes are impinged obliquely against the far side of the pipe, or connection, i. e., the elbow, with considerable force and the result is a severe scouring action which will, in a short time, wear through any elbow of ordinary construction. This abrasive wear is the chief cause of direct deterioration of suction conveyors.

To reduce it the elbows are made with removable backs of hard manganese steel, carborundum, reinforced glass ,or other material possessing high resisting properties. These elbows are placed wherever the general path of the conveyor duct makes a change in direction, and so pronounced is the abrasive action of the fine particles of ashes that the hardest elbow is brought to a high state of polish in a short period of service. The polished surface then tends to reduce the rate of deterioration and, at the same time, to prevent loss of carrying capacity by any slowing down of the rushing air.

The exhaust fan creating the partial vacuum in the storage tank, removes the air from the top part of the tank. Between the exhaust connection and the discharge inlet of the conveyor duct a water spray plays on the ashes as they enter the storage tank, quenching them and precipitating the fine particles which would otherwise be sucked into the intake of the fan. As the operation of the system depends upon the success with which the air is exhausted from the tank, it is necessary that this exhaust tank be made air tight, with admission of air only possible through the conveyor duct, via the opened intakes in front of the boilers.

The ashes being carried in virtual suspension, the carrying capacity of a suction conveyor is quite limited, necessitating more continuous operation than equipment which carries the ashes in buckets or cars. A 4-inch suction conveyor, i. e., one with a conveyor duct of 4-inch pipe, has a carrying capacity but little over 2½ tons per hour, while a 12-inch conveyor, about the largest size employed, has an hourly capacity of somewhat less than 25 tons an hour. The capacity of conveyors between these limiting sizes varies directly as the square of the conveyor duct diameter.

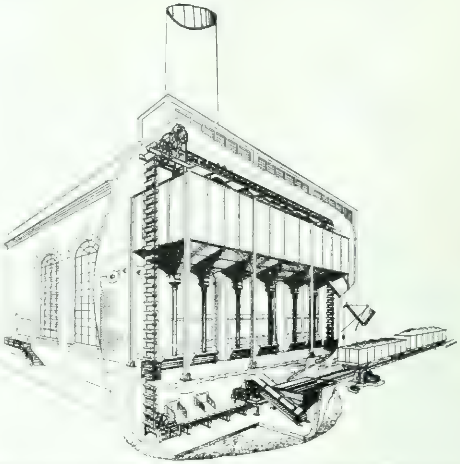
The diameter of the conveyor duct, besides governing the carrying capacity of the system, governs also the size and power of the exhaust fan and, as the exhauster is the chief item of expense, the cost of an installation for one or two boilers is very nearly as great as the cost for one caring for a much larger boiler plant. Also, the consumption of power is nearly the same in a short conveyor system as in a long one of equal capacity. These peculiarities tend to limit the use of such methods of handling ashes to the larger plants where the high initial cost of installation and the cost of maintenance are discounted by continuity of operation made possible by the large quantity of ashes handled.

The net cost of handling 4,500 tons of ashes during the year with an 8-inch suction conveyor, which has an ash handling capacity of 10¼ tons per hour, was, prior to the present high cost of equipment, etc., and including all expenses—interest, taxes, insurance, operating, power, etc.—in the neighborhood of $2,250, that is, 50 cents per ton with power valued at two cents per horsepower hour. Such capacity would entail an average use of the conveyor of 1½ hours, at maximum capacity, per day throughout the year. The same equipment handling 9,000 tons of ashes during the year, calling for an average operating service of three hours per day at capacity, or considerably longer as customarily employed, would have entailed a total expense of about $2,700, or 30 cents per ton.

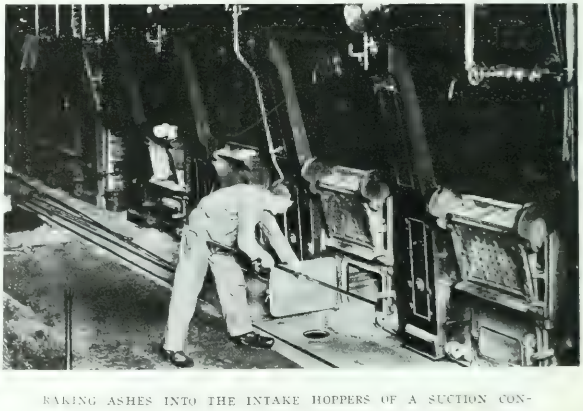
These figures are typical of before the war costs, and would be considerably higher today, even were it still possible to keep the cost of power close to two cents per horsepower hour, as from nearly 90 to approximately 75 per cent. of the respective costs are chargeable to the "fixed charges" established by the initial cost of the equipment. This "fixed charges" item having increased 50 or more per cent., the respective costs per ton would now probably exceed 75 and 42 cents, respectively.

Provided no large clinkers are formed that have to be broken up before feeding to the conveyor duct, there is no question but that the suction system of handling ashes is the most convenient so far evolved. and is to be highly recommended for the plant that can afford the high initial cost of installation. When nothing unforeseen occurs in the boiler room and the suction conveyor is in good operating condition, the system is about as nearly "fool proof" as any system for mechanical handling of ashes can well be, for it is impossible for the careless fireman to force unbroken clinkers, or any other material which might choke up the conveyor duct, through such small intakes as are provided for the ordinary feed of fine ashes. There is one note of warning, however, that should be sounded, for, this point neglected, the highly efficient system might turn out as deadly as a German bomb.

Should it be necessary to pull an active fire in an emergency, a serious accident might occur were incandescent particles of coal passed into the conveyor duct. These glowing pieces lose little of their heat during their brief journey through the conveyor and reach the water spray at close to grate temperature. The still incandescent fuel may give off explosive coal gases and even disintegrate the water vapor, as in the case of a suction gas producer. These explosive gases collect in the pockets formed in the top part of the confined storage tank—despite the suction of the exhaust fan—and have been exploded with disastrous results by a piece of incandescent fuel sucked into the tank. The danger of such an accident is slight, it is true, but the seriousness of the danger makes its mention advisable—particularly as all risk can easily be avoided by the exercise of a little care. A timely word of warning: incandescent fuel should never be fed to the conveyor.



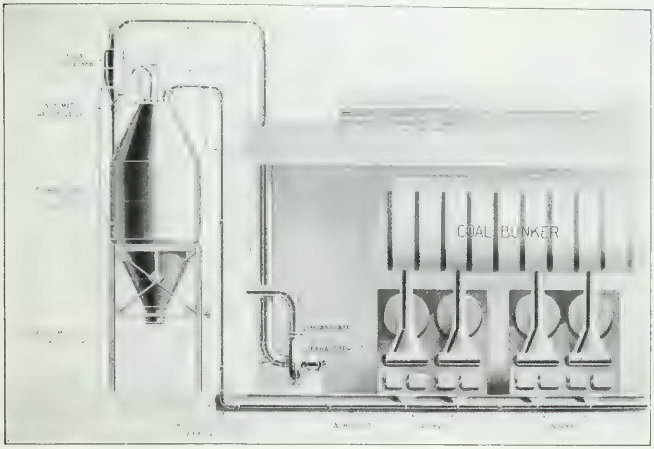
POWER HOUSE EQUIPPED WITH MODERN MACHINERY FOR HANDLING COAL AND ASHES



RAKING ASHES INTO THE INTAKE HOPPERS OF A SUCTION CONVEYOR SYSTEM. CONVEYOR DUCT DIRECTLY BENEATH THE FLOOR

STEAM JET SUCTION CONVEYOR

Another system, one also employing the rush of air through a conveyor pipe, or duct, to carry the ashes in suspension, and one which is more suitable for a plant of small boiler capacity than the more expensive system just described, is a system in which a jet of live steam is directed into the conveyor duct at some point beyond the last intake for ashes—usually at about the point where the conveyor duct rises to elevate the ashes. The steam jet, discharging in the direction of travel, creates a vacuum of 16 or 25 ounces of water and induces a rapid flow of air through the conveyor duct, from any open charging intake. Such an installation will elevate ashes as much as a hundred feet, convey them over horizontal stretches of several hundred feet and up a reasonably tall section of vertical conveyor duct to the elevated storage tank.



GENERAL ARRANGEMENT OF A SUCTION CONVEYOR SYSTEM FOR ASHES

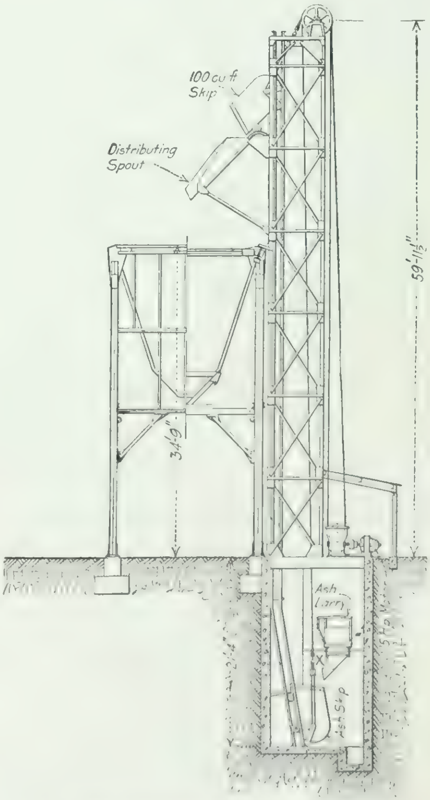
The diameter of the conveyor duct is usually made 6 or 8 inches, and the capacity of the conveyors is usually about the same as that of the more elaborate suction systems, namely, about 5¾ tons per hour for the 6-inch conveyor and 10¼ tons for the 8-inch. To handle such a quantity of ashes, about 7 or 8 per cent. of the steam generated by the boilers cared for is required, but only while the conveyor is in actual operation. In one plant where careful measurement of steam consumption was made, 1,850 pounds of steam, under 110 pounds gage pressure, were required to handle 7 tons of ashes from four 400 horsepower boilers.

In this steam jet vacuum system, the ashes are usually allowed to accumulate in hoppers below the grates and only fed to the conveyor duct during periods when steam can safely be withdrawn from the boilers for the service of creating the required suction in the conveyor duct. The ashes are, therefore, usually comparatively cool when they pass through the conveyor and contact with the steam jet is sufficient to settle the fine particles of dust and deliver the ashes to the storage tank in a suitably quenched condition.

The wear at conveyor duct elbows, etc., is nearly as marked as in the vacuum system employing an exhaust fan, and deterioration may, in this second system, be somewhat aggravated on any horizontal or vertical stretch after the ashes have come in contact with the expanding steam by the formation of acid fumes. However, the storage tank in this system may be ventilated and so allow for the escape of fumes and any explosive gases which may be generated and carried into the tank.

For the power house within the capacity of the steam jet suction conveyor, the system is an economical and convenient one to install. In the plant previously referred to as keeping a record of steam consumption—a plant operating four 400-horsepower boilers, some interesting costs (current in 1915) were estimated. Eight and two-thirds tons of ashes were handled per day, the coal containing about 12 per cent. ash. To economize as much as possible in the use of steam, two men were employed to feed the conveyor duct intakes, the wages chargeable to such operation estimated at 5¾ cents per ton of ashes. The initial cost of the installation had been $1,800, that is, $1,000 for the tank and $800 for the piping, etc. The usual rates for interest on investment, taxes, insurance, etc., would place the "fixed charges" at close to 5¾ cents per ton of ashes. Depreciation of the ash tank was figured at 8 per cent. and that of the conveyor duct, etc., at 40 per cent., adding a depreciation expense of 13 cents per ton of ashes handled. The sum of these expenses and that for the steam, placed at 20 cents per 1,000 pounds, totals to 29½ cents per ton of ashes.

Though some of the items entering into the foregoing calculations may appear to have been rather arbitrarily established, the sum total does indicate quite closely the cost of operating such a system under conditions existing about



ASH HANDLING ELEVATOR EQUIPMENT

1915 about 30 cents per ton of ashes but these figures would be quite materially increased today, as about 60 per cent. of all costs are effected directly by the initial cost of equipment. If the installation should cost $3,000, instead of $1,800—as it now very probably would—and if wages were increased 40 per cent, the cost per ton for handling the ashes would be increased to 46 cents, even though the steam rate might not change from 20 cents per 1,000 pounds.

Pivoted Bucket Carriers for Handling Ashes

In a plant employing pivoted bucket carriers for handling the coal supply, the return run of the carrier can frequently pass under the furnace grates, the buckets loaded through chutes extending from the ash pits and the coal handling equipment thus utilized to carry the ashes to an overhead storage bin from which they may be subsequently reclaimed. The pivoted bucket carriers, when employed to handle ashes as well as coal, should preferably be made of malleable iron, instead of steel, better to resist the deterioration incident to the handling of hot or wet ashes. This possible additional expense, together with the few extra feet of conveying equipment required to conduct the carrier through the ash tunnel below the boilers, and the cost of the power actually consumed in handling the ashes represent the more obvious expenses chargeable to the handling of ashes by such a system—labor being almost a negligible quantity. For this reason, where the layout of the plant permits such an arrangement, such use of the pivoted carrier for handling both coal and ashes has considerable popularity.

Economic as this two service arrangement would appear to be, it has been found of questionable economy in a number of cases. The clouds of fine dust which cannot very well be avoided in the tunnels where the buckets are loaded, are extremely penetrating and cause rapid deterioration and wear of all moving parts. So serious is this point with equipment as expensive as a pivoted bucket carrier system that in a number of plants it has been found advisable to remodel the conveying systems—the coal handling equipment being simplified as much as possible and used only for handling coal and a suction conveyor installed for handling the ashes. Despite the high cost of such ash handling system, the alteration has proved to be a money saver.

Industrial Cars for Handling Ashes

The best method of handling ashes from the boiler room to the outside storage is in hand-propelled industrial cars on tracks in a tunnel passing under the ash pits of the boiler grates. It is advantageous to give the ash car tracks a slight down grade in the direction of loaded car travel, to assist in starting the cars and running them out of the boiler plant. When the tracks issue from beneath the boiler room building, they should lead to a conveniently located charging pit for the elevating equipment to be employed in raising the ashes to the overhead storage bin.

For elevating the ashes to the storage bin, the cheapest and most efficient rig to employ is a simple skip hoist. It presents the fewest number of moving parts for the fine and penetrating ash dust to cut and score, and, when properly counterbalanced—one skip against another, or by plain counterweights—is quite economical in the use of power.

Where an accurate record of the weight of ashes is desired to check against the weight of coal consumed, the industrial cars for collecting the ashes from the ash hoppers beneath the respective boilers may be replaced by ash weigh-lorries of the hand-operated type. By means of these lorries the amount of ashes collected from each ash pit can be conveniently weighed before delivery to the skip-hoist feeding hopper, or, as in the more approved construction, before being discharged directly to the skip.

For small power houses and those of medium size—a few hundred horsepower—the handling of ashes by means of industrial cars and a simple hoisting rig, like the skip-hoist, cannot be bettered. The layout is low in first cost, simple in operation, exceedingly durable, with low maintenance charges, flexible and requires but little power to drive the skip motor. It is almost "fool proof" and, by making the ash hoppers under the boiler grates of generous proportions, ample time is provided for making the rare repairs called for by the rig, so that there is little excuse for a breakdown of the equipment. Furthermore, it is almost as simple as the old time wheelbarrow method of handling ashes, and is much more efficient, neither does it require any skilled or high priced help for attendance or operation.

How Physical Training Helps Factory Executives

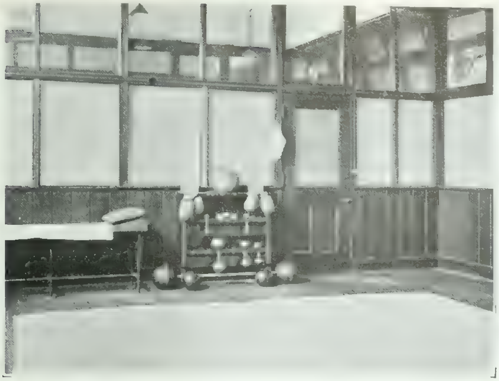
By D. C. Stanbrough

General Superintendent, Packard Motor Car Company

IT is generally conceded by people engaged in vocational occupations that a certain amount of regular exercise is necessary to the physical and mental well being of an individual, but the admission of the benefit does not help unless some ready means for exercise can be provided. The human race is naturally lazy, and the majority of people will not put themselves out to obtain physical stimulation. In modern industrial life, even if an individual is disposed to take proper exercise, the time required can hardly be spared. Most of our large industries are on the outskirts of communities, consequently, considerable time is consumed, even with a motor car, to travel from one's place of business to the club or gymnasium in which exercise can be obtained under proper supervision.

But the question naturally arises, Is systematic exercise necessary to successful industrial life? On first thought the answer will be, No, for the reason that industry has prospered for many years without the gymnasium as a part of its equipment; but, on the other hand, we have many things in industry today which the practice of yesterday would have derided. Today we bring men and women into our factory and give them instruction at good pay in order that they may be able to serve industry. We have established recreation fields with complete athletic equipment for our employees; we have bands, baseball diamonds; bowling alleys and various other forms of amusement and distractions for our organizations.

It does not take much of a stretch of the imagination to realize that the proper care and physical well-being of the executive force is a problem which cannot be put lightly aside, and, under the tension which has come to modern business as a result of the scarcity of skilled executive help, it is absolutely essential to conserve and build up in every way the energies of those carrying the greatest mental burden. The body is the storehouse of the mind and clear thinking can only be stimulated by an active body. Most men who have reached responsible executive positions have arrived through their ability to drive themselves to the issue regardless of their state of health. A capable executive is not a man who will let a headache or any of the minor ills deter him in the performance of his duty. If, through a certain amount



GYMNASIUM FOR THE USE OF PACKARD EXECUTIVES

ANOTHER VIEW OF PACKARD GYMNASIUM

of well directed physical effort, his circulation can be improved and he can be relieved of the bodily ills, he has that much more driving force left to put behind the conduct of his business and he is amply repaid.

Experience of the Packard Company

Our experience at the Packard Motor Car Company in furnishing an opportunity for physical training to our executives is possibly unique, and may be of interest in the guidance of those who desire to undertake this work. In June, 1917, the project was first broached by the Vice-President, Mr. F. B. Beall, who had always made it a practice of taking a certain amount of exercise at a local athletic club, but this entailed a considerable waste of time and, consequently, irregularity as it was not always convenient to go the necessary distance to obtain a "work-out." It was agreed that if the company would furnish the room, that those interested would furnish the equipment, secure a competent instructor and provide for the maintenance of the gymnasium—it being our experience that projects of this nature succeed best if supported by the individuals interested. The equipment at first consisted of: Shower with hot and cold water, electric bath cabinet for skin eliminations, medicine ball weighing about 8 pounds, platform scale of a dispensary type, 70-pound bar bell and a collection of smaller bells, 10 x 10-foot mat, a set of 10-ounce gloves and wall type exercise machine.

The services of a competent instructor who was a graduate of the McFadden School in Chicago was secured and with him part of the equipment.

The plan laid down, one that has since been followed with practically no change, was to give individual instruction to each man, it being realized that the object of the exercise was to stimulate particular individuals, and the result sought could only be secured by complete and individual attention. Instruction was started at 10 o'clock in the morning and lasted until 6 p. m., each individual being given one hour three days a week, the hours being assigned, so far as possible, to suit the convenience of the individual. It was understood, of course, that if a man's hour was from 11 to 12 on Mondays, Wednesdays and Fridays, he had to be there or lose his turn. Inasmuch as each man paid for instruction on a monthly basis, it was evident that it was to the man's interest to get value received. The instructions were varied with the individuals, but they consisted in general as follows:

1. Medicine ball work to warm up.
2. Floor work for the abdomen, neck and chest.
3. Rings to stretch the muscles of the arms and back.
4. A few minutes on the mat, wrestling, or several rounds with the gloves to work up a perspiration.
5. An oil rub.
6. Cabinet bath for about seven minutes or until the individual was perspiring freely.
7. Hot and cold shower.

Only four of the executives made a start at first. However, it was not long before all the hour periods were filled and it became necessary for the newcomers to double up. Today we are handling 22 men six days a week between the hours of 10 a. m. and 6 p. m.

The privilege of the gymnasium is accorded all the executives upon application. A $10 fee is charged those who have the hour periods, while $7 is charged when two men double up.

Some Remarkable Results

Our experience with the gymnasium has shown us several remarkable results. In the first place, the men who have stuck to the course have shown a remarkable improvement in general vigor, have clear skins, clear eyes and give every evidence of the snap and ginger which goes with the well body; second, these men have been remarkably free from illness and the loss of time from illness has been entirely eliminated. In a recent epidemic of ill feeling which hit the factory while approximately 40 per cent. of the office force was under the weather for one or more days, not one of the men taking the gymnasium work was absent on account of sickness. The general results which have been obtained are set forth in the table below. This shows averages and, of course, we all know the average result is the one that counts:

Characteristic	Change
Weight	5.37 pounds
Shoulders	+1.10 inch
Chest, normal	+1.12 inch
Chest, small	+0.35 inch
Chest, expanded	+1.5 inch
Biceps, contracted	+0.75 inch
Forearm, contracted	+0.81 inch
Waist	—2.00 inch
Thigh	+0.69 inch
Calf	+0.12 inch
Neck	+0.44 inch

To get good results from the exercise, it is of great importance that the man be interested in the exercise proposed, and it has been the aim of the instructor to invent and assign exercises which appeal to the men individually.

The two accompanying views show the gymnasium and the simplicity of its equipment.

New Plant of Diamond Chain Company

Features of the Buildings and Equipment for Manufacturing Roller Chain and Sprockets for Power Transmission

A rapidly growing business has compelled the Diamond Chain and Manufacturing Company to erect and equip a new plant. Five older manufacturing buildings have been vacated into the new so that production is now unified at one center. This article takes up constructional and engineering features of the buildings and illustrates a number of the shop departments. A well-appointed labor-maintenance department with rest room, hospital, lunch room and coöperative grocery store are shown in the following pages.

ON a site comprising five acres of land situated only five blocks from the shipping center of the city of Indianapolis, Indiana, at the intersection of Kentucky Avenue and West Street, The Diamond Chain and Manufacturing Company has just erected a new plant which is already employing a thousand workers. This site is less than a block from the main lines of transportation and the plant is served by its own railroad sidings.

The main building is four stories in height with building line dimensions of 60 x 460 feet, has two wings or projections on the front as shown in Figure 1, and three service towers at the rear as shown in Figure 6. The building area of the main building is some 120,000 square feet. Adjoining the main building in the rear is a one story structure with a monitored roof. It is 80 feet wide by 300 feet long and is illustrated in Figure 6.

The layout of these buildings with reference to the site is such that they can be easily added to as the business continues to expand.

The type of construction is reinforced concrete with mushroom columns and a slab floor in the main building, and a column, girder and beam ceiling in the single story building. Figures 2 and 3 show the interior construction of the single story building and Figures 4 and 5 of the main building.

In keeping with the best of modern factory design the side walls of both buildings carry a high percentage of glass to admit a maximum amount of natural light. With the exception of some special departments, as the furnace room, the floor surface is wood laid lengthwise of the floor, that is, in line with the direction of trucking.

The interiors are painted white as shown by the illustrations and the effect of the mushroom column head is to eliminate pockets and surface that would gather dust and to do away with shadows.

The window sash are of steel glazed with clear glass. The heating coils are arranged in stacks on the curtain wall beneath the windows. This feature is well shown in Figure 5. Ventilation to the outside air is obtained through center pivoted sash, a number of which are shown open in this same view.

The overhead fixtures as line shafting, counter shafting, and the like are attached to the slab concrete ceiling with a minimum of drop to do away with the cutting off of natural light.

Artificial lighting is arranged on the system of general illumination with a large number of medium capacity lamps. These are set in rigid fixtures having a considerable drop from the ceiling. Figure 5 again well illustrates this feature.

The service towers of which there are three shown on the rear of the building in Figure 6, contain the wash rooms, toilet rooms, stair cases and elevators. The placing of these utilities outside of the main floor area leaves the latter entirely free from the installation of producing equipment. This feature is well illustrated by the perspectives of Figures 4 and 5. At the left hand of Figure 4 can be seen a rolling steel door, occupying the greater part of one bay, and giving access to the elevator in one of the service towers.

The Single Story Building

The single story building which has been previously mentioned is devoted to the storage of raw stock and a few special departments, as the hardening and tempering room. A general view of the stock storage racks for bar steel is given in Figure 2, and a view in the furnace room is shown in Figure 3.

Raw materials brought in railroad cars are unloaded directly at car floor height. To note this feature refer to Figure 6. Along one end of this storage building is a platform for use of teams. This is also shown in Figure 6.

Steel as unloaded is gaged, weighed and inspected

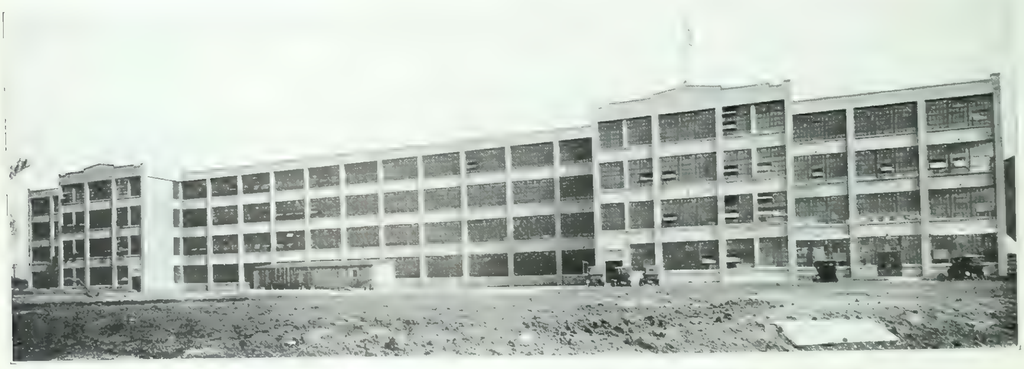


FIG. 1 EXTERIOR VIEW OF NEW FACTORY OF DIAMOND CHAIN COMPANY, AT INDIANAPOLIS, INDIANA

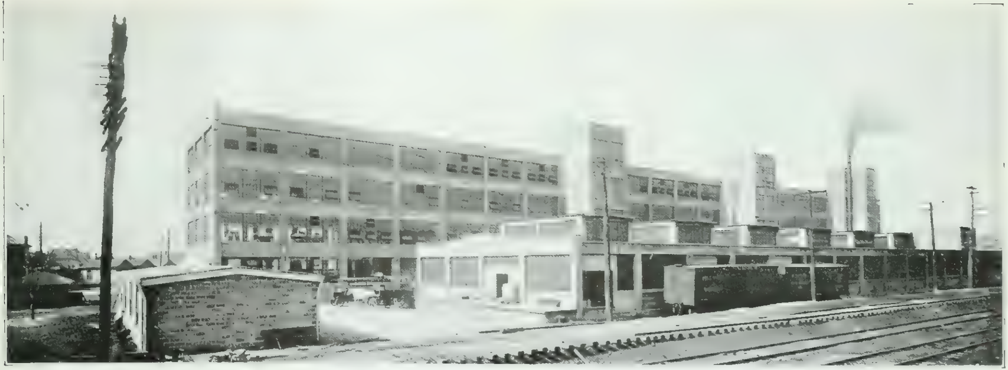


FIG. 6. EXTERIOR VIEW OF REAR OF DIAMOND CHAIN COMPANY'S FACTORY

for quality. It is then placed in proper storage either in substantial metal racks as shown in one of the center bays in Figure 2, or else in convenient piles upon the floor.

The arrangement of the furnace room needs little comment except to point out the monitor with center pivoted sash in the windows for the escape of heat and fumes. The placing of the dipping tanks is a feature worthy of notice for these are stretched out roughly along the arc of circle and are served by a hoist on a bent circular track overhead.

Another department not shown in these illustrations is the rattling room, where the parts after case hardening are rattled to give them the desired finish.

THE ASSEMBLY DEPARTMENT

Figures 4 and 5 show assembly departments. The first is equipped with wooden benches covered with

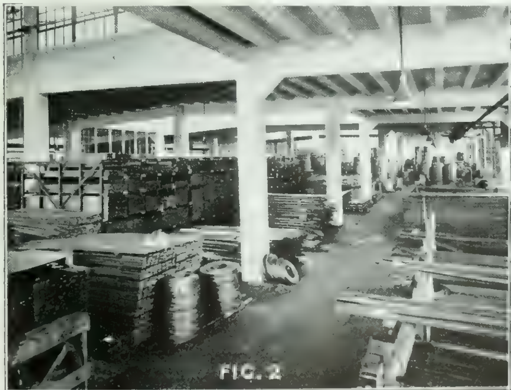


FIG. 2

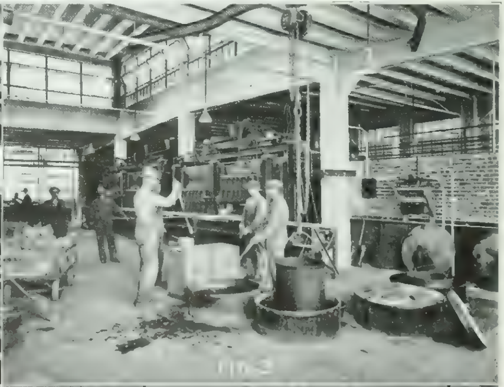


FIG. 3

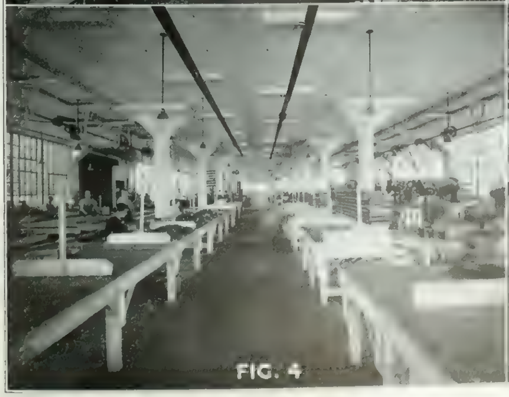


FIG. 4

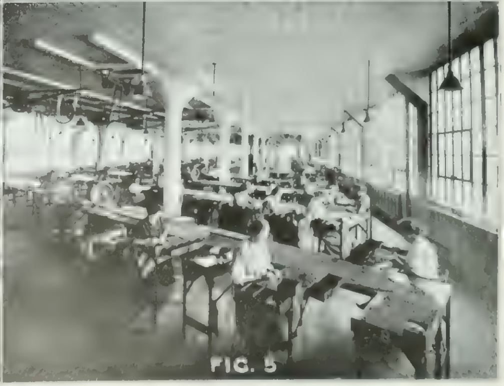


FIG. 5

FIG. 2. RAW STOCK ROOM

FIG 4. FOURTH FLOOR—ASSEMBLY DEPARTMENTS

FIG. 3. [illegible] FURNACE ROOM

FIG. 5. [illegible] ARRANGEMENT OF ASSEMBLY TABLES

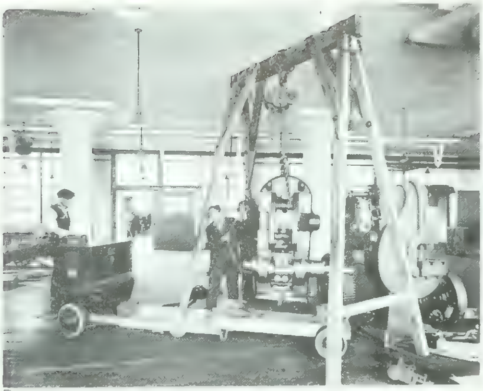


FIG. 8. INSTALLING MACHINE ON FIRST FLOOR

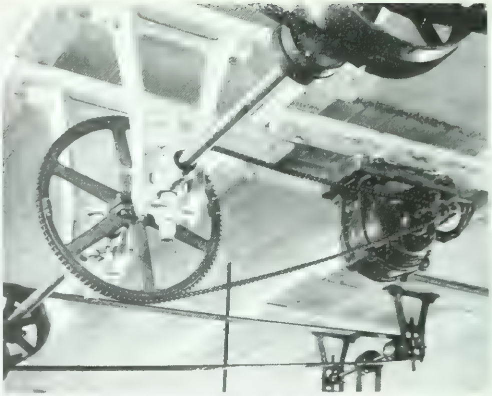


FIG. 9. CHAIN DRIVE IN USE THROUGHOUT FACTORY

metal tops and spaced off into sections, one for each worker. Over the center edges of the benches in the middle aisle hang hoists from I-beam tracks used in lifting and dumping boxes of parts. One of these boxes in a position to be emptied is shown near the center of the view of Figure 4.

Turning now to Figure 5, we see an unusual arrangement of the assembling benches in that they are placed diagonally across the room instead of parallel to the side walls or perpendicular thereto. There are two principal reasons for this plan, one being the economy of floor space and the other the insuring of an adequate amount of natural light for each worker. This system is somewhat new, and possibly in no other plant has it been worked out with more care or detail.

Attention is called to the type of bench used in this department. It is constructed of metal throughout and

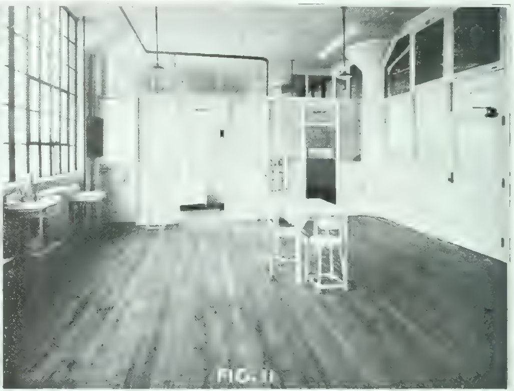


FIG. 10. WELFARE OFFICE, [illegible] ROOM, ETC.
FIG. 12. EMPLOYEES' LUNCH ROOM, THIRD FLOOR

FIG. 11. FIRST AID ROOM
FIG. 13. COOPERATIVE GROCERY STORE

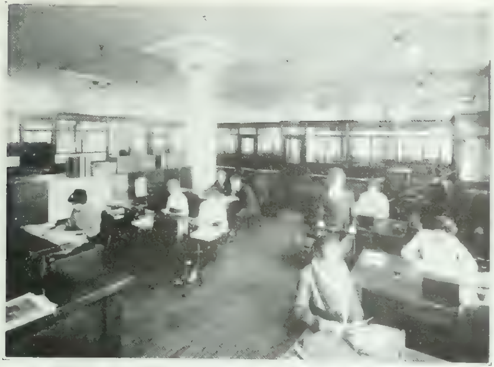


FIG. 7. VIEW IN GENERAL OFFICES

so arranged that each girl has a bench section in front of her and at her left hand and around the edge of her working space can be hung rows of metal boxes for use in whatever classifying of parts is found necessary.

The General Office

Figure 7 is a view of the general office showing that the same type of floor, ceiling and wall construction is preserved and also indicating the type of interior partition which has been adopted to divide the various sections. The artificial lighting of this room is a modified form of indirect illumination in which the reflecting surface is a disk suspended above the lamp and some little distance away from the ceiling.

Figure 8 is a view taken during the process of moving and shows the lifting of a press from the platform of a transfer truck. A detail of the mechanical equipment is also illustrated in Figure 9 which is a view of a chain drive from a suspended motor to the line shaft. The harness work by which the motor is suspended is plainly shown and it will be noticed that the sprocket from which the main line shaft is driven is split and clamped in place, one of the many details that have been so well worked out in this modern plant.

Workmanship As An Efficiency Aim

Are Our Methods Fostering the Spirit of Pride In Work?

By C. W. Starker

In this article Mr. Starker *points out the increasing complexity of manufactured products and scientific character of methods, calling for higher skill and training on the part of all. Efficiency methods, it is contended, frequently are wrongly applied to stimulate the money-making instinct and quantity output, tending to depress instead of raising the average of skill and workmanship.*

Mr. Starker *has for many years been engaged in the manufacture and development of electrical apparatus and has originated improvements in design and construction of alternating and direct current motors for industrial and railway work. As one of the Westinghouse engineering staff he has developed comprehensive systems of cost analysis for manufacturing*

IN GENERAL, efficiency methods have been considered primarily as a means for increasing output or reducing waste in material and in expended effort. Work along these lines has been refined to the point of time studies, and even motion studies, designed to limit the movements of hand or foot to those absolutely necessary. In all these efforts, even the most extreme, there is a great deal of justification, for as time goes on all our work becomes more intensive and the use of man power and material must follow strictly economical lines instead of the wasteful ways of the past.

But are we not inclined to be one sided, inclined to see only the nearest thing, the one that promises direct results and most plainly visible accomplishments? Are we not doing these things at the expense of the more lasting qualities of technical skill and of willingness to contribute to a success even where no direct recognition or material gain is likely? There should exist an ambition, an enthusiasm to do a thing well, better than the next man, a desire to excell in accomplishment, rather than in output.

Forced production, over stimulated by premiums and bonuses, aggravates the condition. Efficiency charts, if based on output efficiency alone, are bound to result in undesirable by-products. They appeal to the greedy, money-making side of human nature, the factor least needing or deserving cultivation. With many of the present mis-termed efficiency methods we may be able to show almost immediate gains in the form of increased output or decreased departmental expense, but we do not gain, we lose in the long run by any one-sided stimulating of the money making instinct. With excessive attention paid to quantity at the neglect of quality, individual skill and ability of doing a thing better than the next man go unappreciated, and the result is that the standard of workmanship and skill is lowered.

Swinging Away from Extremes

There are fortunately signs of the pendulum beginning to swing back from the extremes of motion studies and the like. One of the contributors to Industrial Management (Mr. W. A. Smyth, May, 1917) spoke of the human purpose in work, of unhindered effort and of the personal interest in accomplishing a certain thing instead of "trying to substitute the short cut of imitating, mechanical tricks for the toilsome process of becoming a MECHANIC." This expresses the idea very well, even though we do not agree with the conception that this working with a personal interest is in any way opposed to working efficiently. In fact, real efficiency can only be reached by gaining the personal willingness and ambition of the worker, not by mechanically grinding out product.

Just as Mr. F. A. Sheldon in his "Science of Business Building" points out that the first step toward a sale (of goods, ideas or services) must be to produce in the prospective purchaser's mind a state of desire and interest, so it is necessary in an industrial organization to kindle first an enthusiasm for the work to be performed, selling, so to say, the idea to those who are to carry it out. It does not matter whether it is the enthusiasm of an engineer for his new conception that he must transmit to the draftsman or mechanic who is to carry it out, or whether a foreman or workman creates that spirit of interest in a common success in his helpers, it must pervade the whole organization.

Another contributor to INDUSTRIAL MANAGEMENT, writing on a somewhat different subject ("University Men in Industry," May, 1917) speaks of playing the game for the love of the game. Dollars, he says, are merely counters, stacks of chips in the game. This is perhaps somewhat idealistic for those of us who are in practical life; we still believe "Fair Rewards" to be one of the main principles of efficiency, but it is true that the best efforts in life are put forth, as in games, in the arts or in war, not at all for direct monetary advantage but from personal pride in work performed and the desire to excel over others. In human nature this satisfaction from accomplishment and consequent respect from fellow-workers accounts for more than is generally realized, and this is the attitude of mind that should be cultivated, it breeds a better spirit in an organization than one-sided or excessive use of premium and bonus system no matter how carefully planned.

REPUTATION DEPENDS UPON WORKMANSHIP

The idea should be brought home to every one that the reputation of the company's product, as well as his own chance for success, depends on the workmanship and conscientiousness of each individual worker. In this statement it may be permitted to take the terms workmanship and worker broadly as applying to all occupations from the head of the organization down, and to the skill and training of each in his field. Workmanship in this sense should be an aim, the principal aim in our efficiency methods. Sloppy work, makeshifts of any form, is the surest sign of inefficiency and a disorganized state of affairs. It is a truism to point out that inferior goods may be expensive at any price and that work which needs doing over after a short time is not done efficiently, even if completed in record time. But we do not always recognize this same principle in our own daily routine, when work is done hastily and incompletely, instead of thoroughly and once for all.

Standardizing and simplifying processes with the idea of permitting the use of cheaper, less skilled help is well enough and has the redeeming feature of giving the less able or lower trained men a chance for profitable employment and advance in the scale of living. It also requires the work of particularly high skilled men in devising and making tools for such simplified processes, as for instance dies, automatic machines, etc., but generally speaking, and particularly if carried to extremes, the present tendency in efficiency methods carries in itself the danger of depressing the standard of work performed and the average skill of the men employed.

OFFICE OCCUPATIONS ALSO INVOLVED

The same thought may again be expanded to all occupations, including the offices as well as the shops. What has been said in regard to standardizing and simplifying manufacturing processes applies as well to letter writing, drafting or designing. We may even go farther and say that there lies an element of danger for the future not only in actual depressing of the standard of quality of product and ability demanded of men, but even in the neglect of trying continuously to raise the general level of capability and conscientiousness.

So far as workmanship of the machine-shop mechanic is concerned, it is a fact that the standard has dropped during the last few years to a marked extent, influenced by the high rate of production required and the tendency, not to say necessity, of accepting almost any grade of work turned out. Bad was made worse by the unhealthy conditions of high pay in the early period of munition work. The fact that the stories of fabulous earnings were often enough exaggerations does not remove their unwholesome, disorganizing effect. Greed for money leads to unrest, to shiftlessness and hunting for jobs which pay slightly more, at least temporarily. Hence, the large turnover of help in shop and in offices, so wasteful and harmful to industry as a whole.

PRIDE IN WORK GROWS SLOWLY

The spirit of pride in work performed is easily destroyed, but it takes long years to build it up. We should not forget that those countries which excel to-day in workmanship of mechanics or training of engineers, hundreds of years ago had their systems of apprenticeship and guilds, that jealously watched over the ability of their members. And these old institutions have been revived on modern lines in our days by similar tendencies of both the trade associations and the large corporations. Conditions there are favored in this sense by an oversupply of men, which makes it imperative to acquire high individual training and skill in order to find employment at all, and further calls for continued effort and conscientiousness to advance or even to hold the job. An abundance of work and shortage of men, desirable as this condition is in other respects, has its drawbacks, and the prevailing ease of changing jobs, due to loose methods of employment, as they were in practice at least until quite recently, aggravate the situation.

Under these conditions it is easier to appeal to the money-making instinct of men than to uphold workmanship and discipline, perhaps by threats of discharge or deferred promotion. However, the more this is the case, the more it becomes necessary to counteract the danger of lowering the standard of workmanship of any occupation. All our products are becoming, not simpler and cruder, but much more involved and complex, calling for high skill and training on the part of all. A knowledge of physics, chemistry or metallurgy is needed to-day even in the simplest trades. What of the methods of the old blacksmith in these days of scientific heat treatments and microphotographs to modify and to determine the structure of alloy steels of a complicated nature? What of workmanship and conscientiousness in an aeroplane motor, the weight of which shall not exceed two or three pounds per horsepower, as against hundreds of pounds for the old crude steam engine, and with the life of the crew at stake for any defect in the mechanism? Workmanship is needed to-day to make these things possible, men are needed who can and will do the painstaking, research work on which industrial enterprises are coming to depend. What are our efficiency methods doing to this end?

Boxing Machinery to Prevent Damage

Practice of the Brown & Sharpe Manufacturing Company in Packing Machinery and Tools for Shipment

By Luther D. Burlingame

In these days of war it is a vital responsibility to prevent losses from breakage, rusting and thieving of machinery in transit. This article gives the tested methods of a representative machine-tool building firm. Boxing, crating, wrapping, packing, rust preventing, case marking and invoicing are all shown in detail.

Mr. Luther D. Burlingame, *Industrial Superintendent of the Brown & Sharpe works, served a drafting room and machine-shop apprenticeship with that firm and for twenty-six years was its chief draftsman. He is an active member of the A. S. M. E., chairman of its sub-committee on limits and tolerances of screw threads, and chairman of its committee on standards and measurements. He is a past president of the Providence Engineering Society, a contributor to* Industrial Management *and to technical societies.*

MANY articles have appeared in the technical press during recent years, telling of inadequate packing of machinery and tools, resulting in breakage, rusting and other damage; these complaints have come not only from consuls and foreign agents, but also from home customers. In some cases shipments have suffered, even when well packed, but as a rule it is found that when serious and frequent damage results, the fault can be largely laid to the packing.

Another serious difficulty has been found in thieving from packages in transit.

Many methods to overcome these various difficulties have been followed on the part of those who realize the importance of having the articles arrive in the hands of the customer in good condition. Some of the means which experience has taught to be of value, and in many cases essential, may be grouped under the following headings:

1. Preventing breakage by so boxing and bracing as to protect against not only ordinary handling, but also against rough usage.
2. Protection against rusting.
3. Preventing loss of parts and thieving.
4. Invoicing and marking, including meeting the many varying requirements of countries to which the goods are constantly shipped.

Boxing for Local Delivery

The completeness with which a machine should be boxed depends entirely upon the distance and method of shipment. For local delivery machines can be attached to skids only (as in Figure 1) with loose parts attached securely, and all finished parts covered with waterproofed burlap paper or its equivalent. The machine can then be loaded on a team or truck and delivered anywhere within the range of

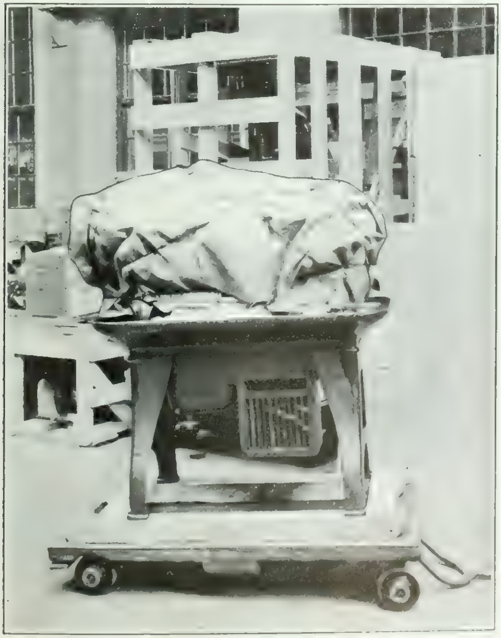


FIG. 1. MACHINE PACKED FOR LOCAL SHIPMENT BY TEAM OR TRUCK

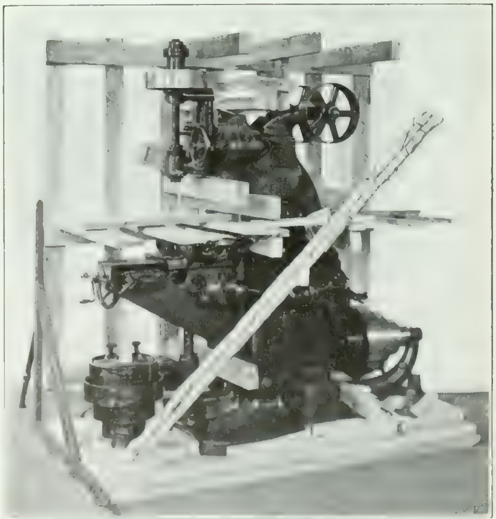


FIG. 2. UNIVERSAL [illegible] MILLING MACHINE BEING CRATED FOR DOMESTIC SHIPMENT. SIDE BEING BOARDED UP

such delivery. But it should not be transported by train or boat in this condition.

If for domestic shipment when either of the latter forms of transportation is required, a machine should be crated, while for foreign shipment it should be completely boxed in.

If the machine is to be reserved for stock, and it is not known whether it is to be for foreign or domestic shipment, it can be crated, so that the spaces left are equal to the widths of the boards used in crating. Then if later ordered for foreign shipment, regular stock lumber will fill in the spaces and make a close board box without repacking. Matched boarding for boxing machines is not used except where specially called for, as for delivery to the American base in France; but for packing small tools, matched boarding is used.

In either crating or boxing machines there are certain principles which it is important to observe.

A. Platform and skids must be strong enough to support the entire machine, and the platform attached to the skids by using heavy spikes which are toed in on a slant both ways, to keep the boards from lifting up when barring.

B. The size of the box should be such that when squared up for length, width and height, there will be an inside clearance of at least one-half inch.

C. The machine should be so blocked in position that if tipped over the weight will be supported and all delicate parts protected. Blocking should be placed lengthwise of the grain so as to be less affected by swelling and shrinking.

D. The top should be sufficiently strong, so as to support any crushing strain which comes on account of the use of a sling in handling when loading on vessels, etc.

A number of years ago, Mr. J. F. Monaghan, then counsel at Chemnitz, Germany, reported on a shipment of 40 cases of machine parts from America which were much damaged in transit, and called attention to the serious breakage which occurred even though the cases in which the machines were shipped were of rugged construction. He says:

> The main fault was that the cases were much too spacious for their contents. The heavy material was given the opportunity to flop from side to side, and hence was subjected to tremendous strain when being handled and on a rough, rolling sea. The more delicate parts (slides, glass plates and reflectors) should have been packed in separate boxes, with a liberal use of excelsior, or other soft material. Wrenches, latches, bolts, etc., should have been put up in small boxes.

Crating a Vertical Milling Machine

The crating for domestic shipment of a No. 1 vertical spindle milling machine is illustrated in Figures 2 to 4. Figure 2 showing the method of constructing the platform and skids, the three skids used in this case being each 2 x 8 inches, and the platform made of 1⅛-inch boarding, on top of which is ⅞-inch crating.

The machine is made to rest, not on the outside frame of the base, but at a point as nearly as practicable under the frame of the machine itself. This is partly illustrated in Figures 5 and 6, where the support was intermediate between the outside of the base and the lines of the frame, and where, when the box was dropped on an obstruction making a deep bruise as shown at *A*, Figure 6, a corner of the heavy cast-iron base of the machine was broken. It will, of course, be understood that no possible form of packing can always secure a machine against such accidents; another illustration of this being shown in Figure 7, where the base of a milling machine was broken at Genoa, Italy, when the box was dropped with sufficient force to crush the skidding and platform as shown. It must be borne in mind that a box containing a valuable machine of great precision is of no more interest to a laborer or longshoreman handling it than would be a box of rough building materials, little attention often being paid to the marking warning against rough handling, no matter how prominently or in what language.

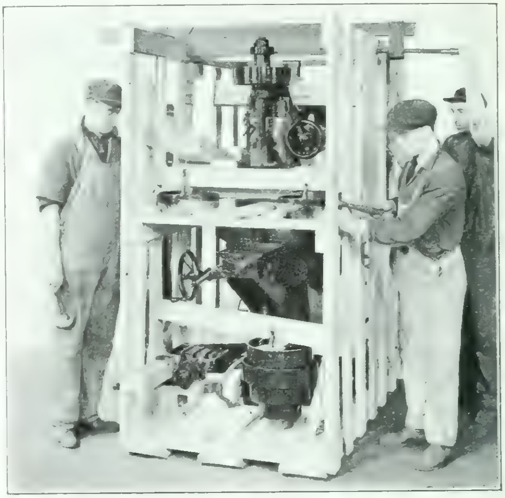


FIG. 3. VERTICAL SPINDLE MILLING MACHINE BEING CRATED FOR DOMESTIC SHIPMENT. CLAMP HOLDING SIDES IN PLACE FOR NAILING

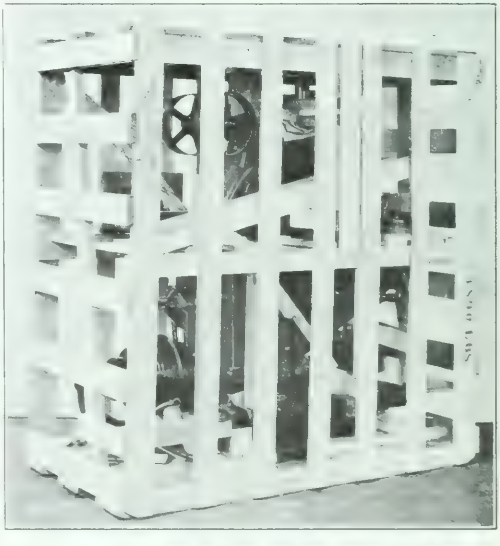


FIG. 4. VERTICAL SPINDLE MILLING MACHINE CRATED AND MARKED FOR DOMESTIC SHIPMENT

Referring again to Figure 2 it will be seen that the base of the machine is held by blocking, paper being used between the blocking and the painted surfaces of the machine to avoid, so far as possible, bruising the paint.

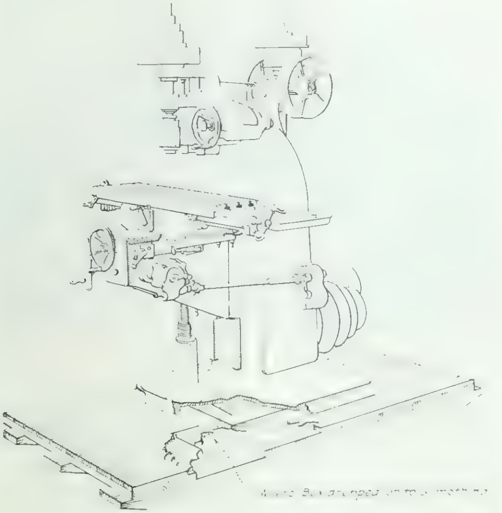


FIG. 5 VERTICAL SPINDLE MILLING MACHINE BROKEN IN TRANSIT BY BEING DROPPED

It will also be noticed that the table of the machine is removed and located on the top of the platform to the left of the machine, being held down by blocking passing back of the knee screw. The surfaces of the ways on the saddle are covered with waterproof burlap paper before the blocking which is shown in the illustration is put in place. The shafts are wrapped in waterproofed paper covered on the outside with newspaper and placed diagonally in the box. The cone pulley shown at the left rests on blocking; additional blocking cut out to fit the size of the small step of the cone is then nailed on top of the lower blocking. A wooden plug is passed through the hole in this cone pulley and held by the blocking shown above. The counter-shaft hangers are not only held down by the blocking, but also by lag screws. The large wooden square used for squaring up the sides of the crate is shown at the left, also a brace made of piping and attached temporarily to the floor and having a right- and left-hand coupling for adjusting and for holding the sides in place where squared up.

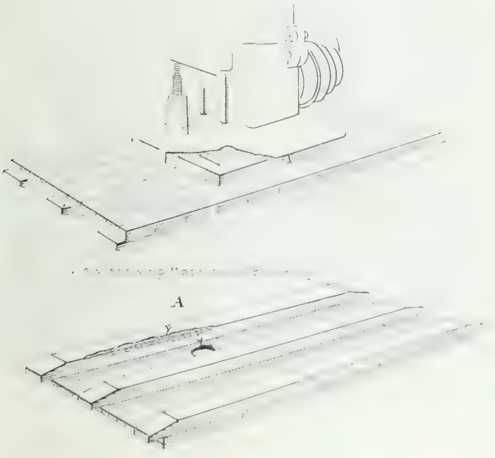


FIG. 6 VERTICAL SPINDLE MILLING [illegible] PLATFORM AND SKID [illegible]

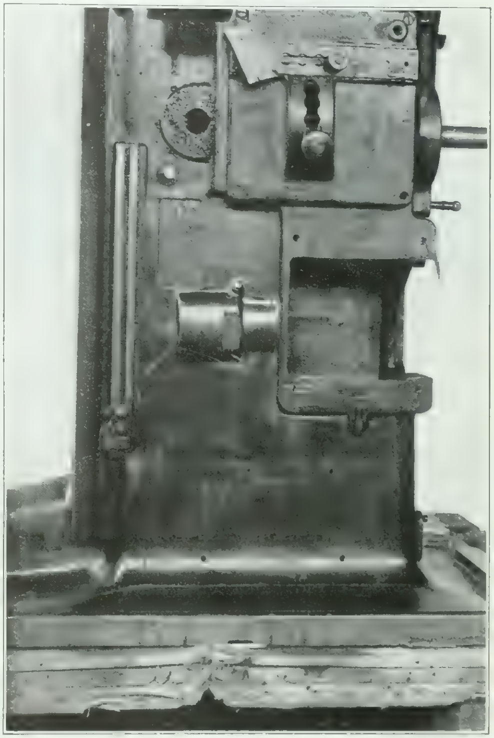


FIG. 7 NO. 3A HEAVY UNIVERSAL MILLING MACHINE BROKEN IN TRANSIT

In Figure 3 the two sides of the crating have been put in place and a clamp is shown at the top, holding them for nailing. In Figure 4 the crating is shown complete with the required lettering stenciled on. Under the top cover is a layer of burlap waterproofed paper which is used in all cases where a machine is either crated or boxed.

Boxing Universal Grinder

Figures 8 to 11 show the complete boxing for foreign shipment of a universal grinding machine. In this case the platform and skids are essentially the same as already described for the crating of the vertical spindle milling machine, and the method of holding the hangers, pulleys, etc., is also similar.

All loose covers, and parts which might become loose, are wired in position, or packed separately.[1] The table is lifted from its ways, which are slushed with thick lubricating grease, as is also all interior

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[1] [illegible] the machine is a convenient place to pack [illegible]

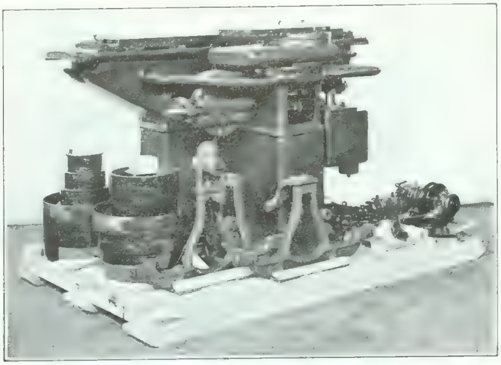

FIG. 8. UNIVERSAL GRINDING MACHINE BEING BOXED FOR FOREIGN SHIPMENT

finished mechanism, the outside being slushed with a heavy compound. Pine strips are inserted between the table and its ways and the table rests on these. This is for the purpose of separating the teeth of the table rack and pinion so that shock in transit will not break the teeth.

Figure 9 shows in the foreground the box in which the grinding wheels are packed in sawdust. In this case the cover is screwed on rather than being nailed to reduce the danger of breaking the wheels. This box is so located that it can be removed readily without disturbind other parts of the packing in case the machine is ordered without grinding wheels—a provision which it is important to make in packing certain parts of many kinds of machines.

The cone pulley shown at the right has projecting hubs and can thus be held in position by the hubs fitting in holes in the blocking.

Figure 10 shows the gang of four men who work together in boxing machines, one of these men being the gang boss and the others working with him.

The packing of all regular machines is standardized, and after once having been declared satisfactory, a card record is made of all of the details of the boxing and a stick marked with important dimensions is kept also for the job, so that a new gang of men, who have not boxed the particular machine before but are familiar with the Brown & Sharpe methods of boxing, can from instructions make use of the previous experience obtained in boxing that particular kind of machine.

Figure 11 shows the use of metal box strapping bands to strengthen a machine after boxing, also the method of using a sling in handling the boxed machine at the works for shipment or storage.

It is also important that a machine before boxing should be handled in a way to avoid danger, both to the workman and to the machine, and precautions in this direction are shown in the method of handling the gear cutting machine, Figure 12, where *A* is a block of wood inserted so as to provide a holding point and also to avoid chafing or cutting of the rope, *B* is a protecting strip of leather, *C* is a wooden block back of the shaft to prevent the pull of the rope springing it, *D* is a cloth to protect the shaft and rope, and at *E* is shown an extra knotting of the rope as a precaution against slipping.

Precautions Against Rust

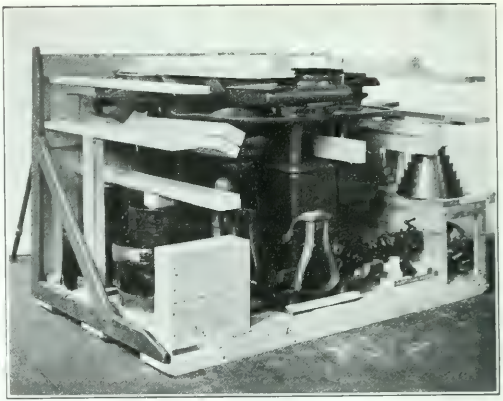

FIG. 9. UNIVERSAL GRINDING MACHINE—SIDE OF BOX BEING SQUARED UP

Mention has already been made of the fact that the inside finished parts of the machine are slushed with thick lubricating grease, while the outside finished parts are slushed with a heavy compound.

This compound was selected by exposing to the weather during long periods of time various samples coated with different preparations and selecting that which stood the test most satisfactorily. Further tests are made from time to time to see that the standard for resisting the elements is maintained.[2]

Several kinds of specially prepared papers are used in packing, as it is found that newspaper, or any ordinary white paper, even when used over the slushed surfaces, will encourage rust. A special paraffine paper coated on both sides, of a make known as "Swedish base" paper (70-pound weight), has been found to be most satisfactory for this purpose. The waterproofing which is used inside the cover of boxes and crates is made of a prepared tar paper with burlap rolled in, and this is also used to put an additional covering over the entire box when the shipment is such that there is a probability that the case will be exposed for a long period to the weather. This especially applies to large cases which cannot be put in box cars and where, due to

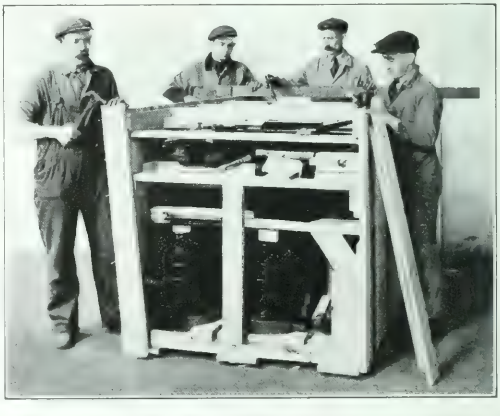

FIG. 10. BOXING UNIVERSAL GRINDING MACHINE, SHOWING REGULAR GANG OF FOUR MEN ON JOB

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[2] It will be noted by Figure 10 that a man with a brush is on duty to give the final touching up to any spots where the grease or compound has been rubbed off in packing.

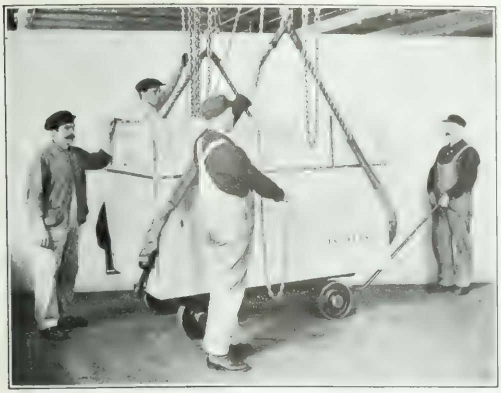


FIG. 11. MACHINE BOXED FOR FOREIGN SHIPMENT AND BEING PLACED ON TRUCK BY USE OF "SLING"

congestion of shipping, boxes may stand in exposed places for long periods. Figure 13 shows a machine so protected.

For small tools what is known as the "Puritan" brand of oil is used to protect all finished surfaces before being wrapped in the paraffine paper. This serves both the purpose of a lubricant and to prevent rust.

For general packing of small tools a heavy waterproofed paper (15-pound weight) is used. It is not so heavy and stiff as the burlap paper.

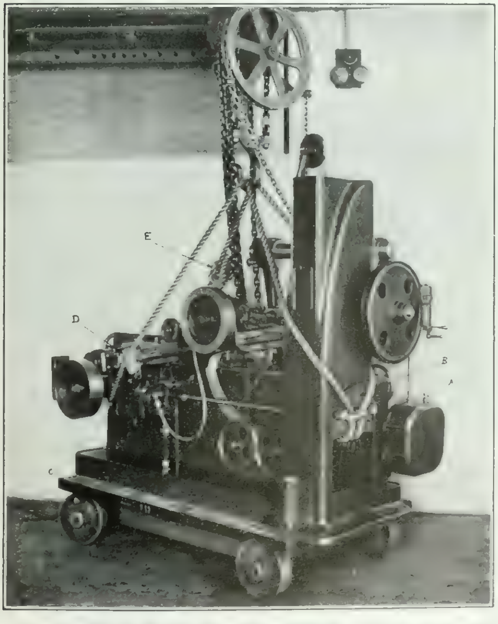


FIG. 12. METHOD OF LIFTING A GEAR CUTTING MACHINE BY MEANS OF A ROPE SLING SO AS TO DISTRIBUTE THE WEIGHT, AVOID ANY TENDENCY TO CHAFE THE ROPE OR TO DAMAGE THE MACHINE

Often in the case of machines prepared for shipment as above outlined, there can be great exposure without the machines being materially injured. Several experiences can be recounted where boxed machines have fallen overboard in salt water, and been under water for a number of days, or even weeks; and when recovered and taken apart have been surprisingly little damaged.

A case which came up for attention within a few days was one in which two No. 2 vertical spindle milling machines which had been shipped to go to Russia more than a year ago, were returned after being in transit and exposed for more than a year, as indicated by the outside of the cases, which showed the effects of the weathering and rough handling, and the boxes were returned tipped over on their sides.

As the blocking seemed to be all in position, it was a question whether the machines should be reshipped without unpacking, but as a matter of precaution they were unboxed and gone over thoroughly for alignments and for general condition. They were found to be entirely undamaged and in perfect condition for reshipment.

For foreign shipments in some cases, especially for small tools, a complete zinc lining of the box is ordered even though at extra expense, which, when the goods are enclosed and the lining soldered, make a complete protection against rust from outside causes.

There seems to be a difference of opinion as to whether under some conditions, waterproof covering may be a detriment rather than a help in preventing rusting, because it is claimed by some that when the dampness once penetrates the covering or boxing that it is then held in so as to do more damage than if left open, so that the air can circulate and dry it out quickly. This naturally depends upon the care with which the machines are originally protected and it is believed that when properly protected the more thorough the provision for keeping out dampness the better the condition in which the machine will arrive.

Prevention of Loss of Parts and Thieving

The more thoroughly a machine is packed, the more care is needed in unpacking, to see that none of the parts are lost. An illustration of this was cited where parties receiving a machine wrote back and stated that certain parts found on the "packing list" were missing. After considerable correspondence and insistence that the parts had been properly packed, a search in the boiler house, where the boxing had been burned, disclosed the remnants of the missing parts which had been through the fire, these having been shafts packed in a long box which was mistaken for a blocking timber and treated accordingly.

In another instance, after long discussion, the foreman of the packing department went some distance to the city, where the machine complained of had been unboxed. He was laughed at for having taken the trouble to come in search of the missing parts because everything had been looked over repeatedly and they had not been found. As, however, several machines had been unboxed at the same time, he quickly discovered the missing parts among the packing of one of the other machines.

By having a packing list, Figure 14, signed by the inspector and verified by the man who boxed the machine, there should be little danger of parts being overlooked when shipping.

In the case of some small parts, it has been found advisable to make the box in which they are packed larger than would be otherwise required, in order that it may not be overlooked and thrown out. Even painting such a box red has sometimes been resorted to, to attract attention to it.

The more a machine is dismantled in shipping, the greater the danger of parts being lost, or of difficulty in assembling, where the mechanism of the machine is not fully understood. In some such cases special instructions, in addition to printed treatises showing the mechanism of the machine, are needed as an aid in assembling.

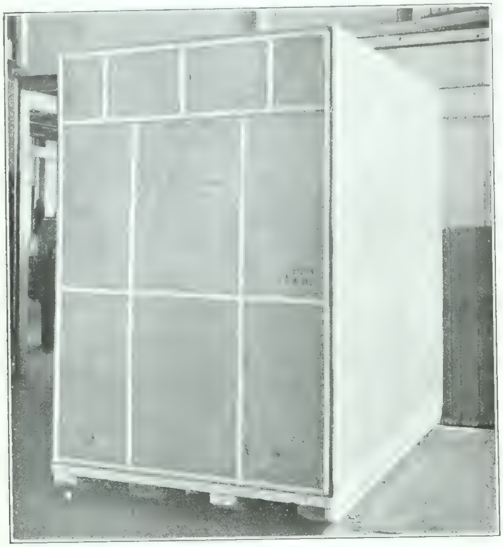


FIG. 13. MACHINE BOXED AND PROTECTED BY OUTER COVERING FOR TRANSPORTATION ON OPEN CARS, ETC.

At times the work of thieves has been especially troublesome, and boxes of small tools have arrived abroad filled with bricks instead of the tools they started with. Special steps have been taken by shippers to break up gangs of thieves who were organized for such thefts and devices have been adopted to prevent boxes being readily opened. Such a device is shown in the sketch, Figure 15, where a clip is driven into the boarding at the edges, this clip has a hole in each projecting tongue, and through these holes an arrow-shaped spike is driven, locking the clip in place. Other means also have been used, but there is a question whether the clipping of a box in such a way as to give evidence that it contains valuables which it is desired not to have stolen, may not call the attention of thieves to the fact that such a box would be worth their efforts to open, and thus make it a special object of their depredations. This difficulty is also aggravated where the valuation must be marked on the box to meet customs and insurance requirements.

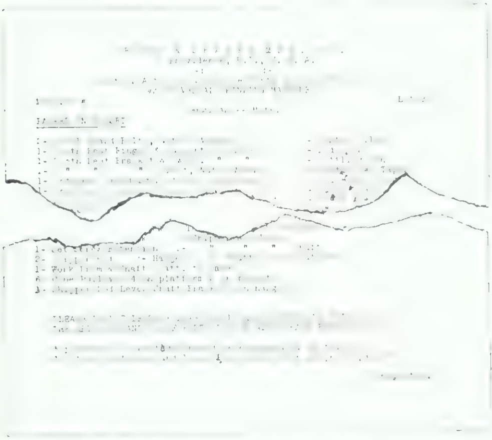
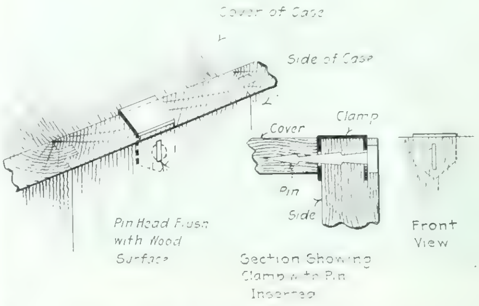


FIG. 14. PACKING LIST, ONE COPY OF WHICH GOES WITH INVOICE AND ANOTHER PACKED WITH MACHINE


Cover of Case
Side of Case
Clamp
Cover
Pin
Side
Pin Head Flush with Wood Surface
Section Showing Clamp with Pin Inserted
Front View
FIG. 15. SAFETY LOCK TO PREVENT TAMPERING WITH BOXES IN TRANSIT

INVOICING AND MARKING

Special rules are followed for the marking of boxes and crates containing machinery, covered by the sheet of instructions, Figure 16; and such marking is further shown in the illustrations, Figures 4, 11 and 13.

The object of marking on both ends and sides is so that whenever boxes are stored, either at the works or in transit, whichever side is exposed will always designate the contents. Very rarely special mark-

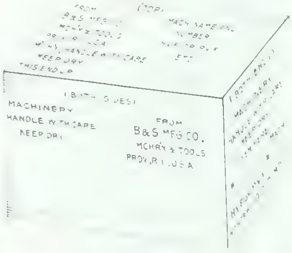


FIG. 16. MARKING FOR MACHINERY WHEN BOXED

All machines must be marked on top, on both ends, and on both sides. They must also show name of machine, size, serial number, whether it is hand or power vertical feed, also whether it has a pump or no pump.

If a machine is fitted with (or for) motor, with metric screws and dials, with friction clutch, or any other special work, it must be marked on case, directly under machine name and number. Milling machines, grinding machines, and gear cutters, must be marked as shown above

SCREW MACHINES MUST BE MARKED

On top with,—Machinery, Handle with Care, Keep Dry, This End Up. from B. & S. Manufacturing Company, Machinery & Tools, Providence, R.I.U.S.A. Open Here, Machine Name and Number, Also with attachments, if any.

On both sides with—From B. & S. Manufacturing Company, Machinery & Tools, Providence, R.I., U.S.A.

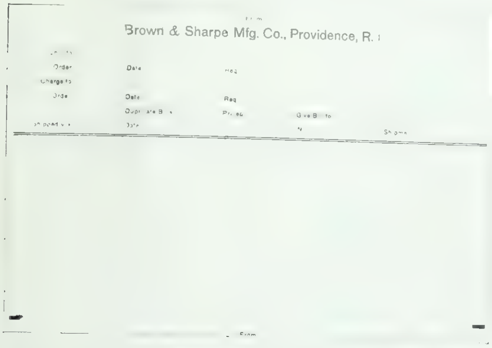
On both ends with—machine name and number, Also with attachments, if any

Overhead works not packed with machine, must be marked:—From B. & S. Mfg. Company, Machinery and Tools, Providence, R.I., U.S.A. Also machine name and number

Brown & Sharpe Mfg Company

Jan 1 1908

ings in foreign languages or in metric dimensions are called for, but as a rule, English dimensions and weights are fully understood and accepted throughout the world. Much miscarriage in shipping is caused by putting the marking on tags or cards instead of painting directly on the box or crate. It pays to go to the additional trouble which the latter method entails. Carelessness in leaving on old marking when using second-hand material in boxing or crating is also a frequent cause of misshipment.


From
Brown & Sharpe Mfg. Co., Providence, R. I

Order Date Req
Charge to
Order Date Req
Duplicate Bill Priced Give Bill to
Shipped via Date Shipment

From

FIG. 17. FORM USED FOR RECORD OF SHIPMENT OF SMALL TOOLS

Many special requirements of invoicing have to be met in different countries, and the questions of weights of packages sometimes materially affect the charges. Forty cubic feet are usually reckoned a ton whether or not that is the weight, so that a little care in packing so as to reduce the cubic contents may make a material reduction in the charges.

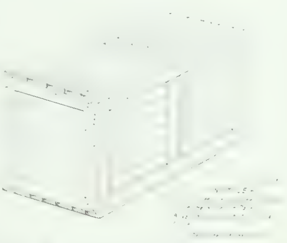


FIG. 18. STANDARD SYSTEM OF NAILING PACKING CASES

Books of instruction are on the market which give the information as to what are the conditions and requirements in each country, so that these conditions can be complied with, and thus avoid expense and delays.

One matter, attention to which can often save expense or unsatisfactory shipping, is to keep the dimension of the box of such a height as to make it possible to have it enter the door of a box car.

The box for the vertical milling machine, as shown in Figure 3, would, if following the ordinary methods of measuring, come a little too high to enter the door of a box car; therefore the upper part of the cover is cut away to clear the upper end of the spindle so as to keep the height down to the minimum. Saving this inch or two of space makes all the difference whether the machine can be sent in a box car or must be shipped on an open flat car.

The traffic requirements often mean special provision, such as furnishing the weights of the different metals used in the construction of the machines, giving separate weights for items like wrenches, pumps, change gears, electric motors, etc., and these must be stated accurately, within quite close limits, to avoid fines or delays when reaching the foreign custom house; although in France, where such regulations are exacting, no objection is raised as to weights being stated in pounds rather than in metric terms.

In shipping small tools it is found convenient to use a manifold form, Figure 17, for billing, producing six copies, so that one can be kept for each of the following purposes: 1, for the office; 2, in the stock room for record; 3, to be packed and shipped with the goods; 4, for a numerical record of the shipment; 5, for an alphabetical record of the shipment; 6, for the correspondence room. These are designated by using different colors of ink, and are filled in on a "Fanfold" billing machine, the blanks being made up in strips of one thousand sets each, each set being torn off after filling in.

To secure satisfactory results in boxing machinery it is important to make use of experience previously obtained, and much can be learned from the troubles which occur, as well as from shipments which go through satisfactorily.

At one time, many years ago, there was a "rounding up" of everyone who had to do with the packing, by Mr. Richmond Viall, then superintendent of the Brown & Sharpe works, and the law was laid down with emphasis as to just how things should be done, not only for thorough safety in methods of packing, but also for convenience in opening the box by the customer. The question was also discussed of giving the customer full information as to just how the box was fastened, so that he could open it as intended.

This was pressed home with such emphasis that, as a joke, some of the officials had the accompanying diagram, Figure 18, made to illustrate just how it would look if an attempt was made to point out to a customer where every nail and fastening was located. But, nevertheless, the emphasis laid on the importance of such work, by men having the force of character and persistence in following up their ideas represented by Mr. Richmond Viall, has had a lasting influence on the thoroughness and good judgment with which such work has since been done.

At a time when there is not only the hazard of carelessness but also that of intentional injury to machines in shipment on the part of enemies, it becomes doubly important to pack and box them so securely that there will be a minimum of loss. Every delay and expense caused by damage to machines in shipment becomes just so much of a delay in the efficient prosecution of the war; so that to the saving of cost and giving satisfaction to the customer is now added the further reason of patriotic conservation by preventing losses in shipment.

How Do You Regulate the Use of Company Automobiles?

A reader of INDUSTRIAL MANAGEMENT asks for information as to methods in force to regulate the use of company automobiles. He writes that his company has six machines and three chauffeurs. Some of the executives run company cars; other executives run in their own cars and the company pays for the gasoline.

Will not those who have faced this problem of regulation and solved it, make some suggestions and kindly send in details of the methods they have devised and put into effect?

Time Studies for Rate Setting on Gisholt Boring Mills—I

By Dwight V. Merrick

In this article of Mr. Merrick's series he takes up the preparation of a boring mill for the work to be done. Seventeen short tables give all the necessary data. Each table is devoted to a single operation; moving rail by power, loosening and swiveling head, removing and replacing tool post or bar, setting chuck jaws and the like.

Mr. Dwight V. Merrick *served a three years' machinist apprenticeship in the shop of the Southwark Foundry & Machine Company, going from there as a journeyman machinist to William Sellers & Company, where he remained for one year. He then spent two years in the engineering course at Drexel Institute. At the completion of this he went back to the Southwark Foundry & Machine Company and served as a draftsman for three years, leaving in 1898 to go with Mr. Frederick W. Taylor at the Bethlehem Steel Company. In 1901 he left Bethlehem to go to the Link-Belt Engineering Company, where he remained until 1911, devoting himself to time study work. The following two years, 1911-1913, were spent in time study in the shops of the Watertown Arsenal. From 1913 to date Mr. Merrick has devoted himself to a consulting practice in time study, giving most of his efforts to the H. H. Franklin Manufacturing Co. and to the manufacture of rifles, ammunition and machine guns.*

THE accompanying tables comprise nearly all the complete operations necessary to prepare a boring mill for the reception of any job. It is presupposed that the machine is in its normal condition at the time and that the work is of such character as to necessitate a change from this condition. The operations comprised in the preparation and the tables of unit times relating to them are as follows:

Operation	Tables
Oil machine	1
Move rail by power	2, 3
Swivel head to angle	4-A, 4-B, 5-A, 5-B
Remove and replace tool post or bar	6
Change position of tool post	7
Set chuck jaws on table, 30 to 42-inch mills	8
Remove chuck jaws from table, 30 to 42-inch mills	9
Set chuck jaws to line, 60 to 84-inch mills	12
Remove chuck jaws from table	13
Reverse chuck jaws, 30 to 42-inch mills	10
Reverse chuck jaws, 60 to 84-inch mills	14
Move jaws on table, 30 to 42-inch mills	11
Move jaws on table, 60 to 84-inch mills	15

The normal condition of the machine must be determined separately for each shop. There also must be provided a tool stand, on which tools, equipment, drawings, instruction cards, etc., are kept. The tool stand should be placed about three feet from the machine and in such a position that the workmen can reach any article on it with a minimum of trouble.

In using the tables herewith, relative to preparing the machine for the work, a survey of the job is first made to determine what changes from the normal condition of the machine are necessary, and the operations necessary to make these changes are listed in the instruction card in the order in which they take place. The time required for each operation is taken from the appropriate table and set opposite that item in the instruction card.

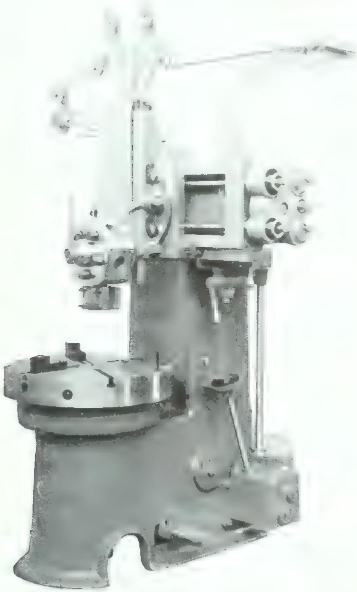


FIG. 1. TYPE OF 30-INCH BORING MILLS USED FOR TIME STUDIES

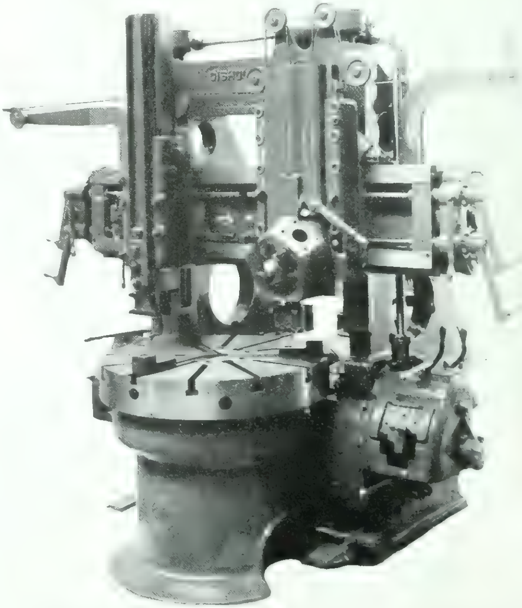


FIG. 2. TYPE OF 42-INCH BORING MILLS USED FOR TIME STUDIES

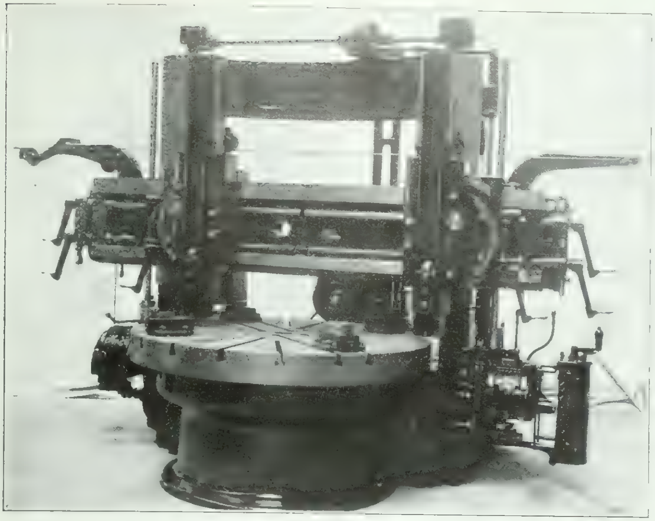


FIG. 3. TYPE OF 60 AND 84 INCH GISHOLT BORING MILLS UPON WHICH TIME STUDIES WERE MADE

Such deductions as the conditions may require are made from the total time as given in the tables, and the net times only are entered on the card. For instance, if the preparation of the machine involves both the raising of the rail and the swiveling of the head, the workman should procure the necessary wrenches for both operations in a single trip to the tool stand, and this fact should be so stated on the instruction card. The time allowed for swiveling the head then would be the total time given in the table, less the time for returning the Wrenches used for that operation. These would be returned with the wrenches used in raising the rail, when that operation is completed. The time allowed for raising the rail would be the total time given, less the time for procuring the wrenches. The detailed operations are given in the tables partly to enable such modifications to be made, but mainly to establish a standard practice based on the methods of the best workmen and on careful studies and correction of these methods.

TABLE 1

PREPARATION OF MACHINE FOR WORK—30 TO 84-INCH MILLS

Details of operation	Oil can No.	Size of Machine in Inches				
		30	36	42	60	84
1. Carry cans to right side of machine		0.09	0.09	0.09	0.10	0.11
2. Fill oil holes in feed box	1	*(24)1.44	*(24)1.44	*(25)1.50	*(28)1.68	*(32) 1.92
3. Fill reservoir of lower feed box	2	0.27	0.28	0.30	0.35	0.41
4. Fill reservoir of rapid-travel mechanism	2		0.16	0.16	0.17	0.18
5. Fill reservoir on upper-rail bracket	2	0.51	0.52	0.53	0.56	0.63
6. Fill six-pipe sight-feed oiler	2	0.70	0.70	0.70	0.70	0.70
7. Fill reservoir	2	0.16	0.16			
8. Fill reservoir for lubricating back gears	2			0.18	0.18	0.18
9. Fill 3-ounce oil cup	2			0.30	0.30	0.30
10. Pick up cans, walk around motor				0.08	0.09	0.10
11. Fill reservoirs on pinion shaft	2			†(3) 1.20	†(6) 2.40	† (4) 1.60
12. Fill cup on shaft under motor	2			1.80	1.80	1.80
13. Fill 3-ounce oil cups	2			†(2) 0.60	†(3) 0.90	†(3) 0.90
14. Pick up cans, walk to left side of machine				0.07	0.08	0.09
15. Fill reservoirs of lower feed box	2			0.30	0.35	0.41
16. Fill reservoir of rapid travel	2			0.16	0.17	0.18
17. Fill reservoir on upper-rail bracket	2			0.53	0.56	0.63
18. Fill oil holes in feed box	1			*(25)1.50	*(28)1.68	*(32) 1.92
19. Climb on table				0.15	0.17	0.20
20. Fill oil holes	1			*(6) 0.30	*(9) 0.54	* (9) 0.54
21. Descend from table				0.06	0.08	0.11
22. Remove cars to stand		0.08	0.08	0.09	0.09	0.10
23. Clean hands with waste		0.20	0.20	0.20	0.20	0.20
Total time for oiling machine		3.45	3.63	10.80	13.15	13.21

*Number of oil holes. †Number of oil cups.

OILING THE MACHINE

The boring mill should be oiled every day before beginning work, provided that it is in constant use. If it is used intermittently, it should be oiled before beginning the first job of the day. The oiling preferably should not be made a part of the preparation time of a job, but should be cared for by a separate time card issued to cover that operation only. Refer to Table 1.

MOVE RAIL BY POWER

The operation of moving the rail by power naturally divides itself into three parts: 1. Preparation, involving the procuring of tools, loosening clamping nuts, engaging of the necessary levers, etc.; 2. actual movement of the rail; 3. clamping the rail in its new position and returning the tools to the tool stand. The details of (1) and (3) are given in Table 2, and the time for actually moving the rail a given distance, together with the total time for the complete operation, is given in Table 3. Ordinarily, in the preparation of instruction cards the totals in Table 3 only would be used. For instance, this particular item on the card for, say, a 42-inch mill would read, "Move rail 10 inches. . . . 1.734 minutes." This operation can be performed only on 42-inch and larger machines. The rail is in a fixed position on the smaller machine.

On certain machines the number of clamping nuts on the right- and left-hand housing differs, thus accounting for the difference in time for loosening or tightening nuts on the opposite side of the machine. (Table 2.) The chain drive transmitting power to the elevating screws of the rail is set in motion by throwing the lever *D*, shown in the sketch. The clutch connecting the rail to the elevating screws is meshed by the lever *E*, and the rail will continue to move as long as this clutch is in mesh. When the rail has reached the desired elevation, the lever *E* is released and the chain drive disengaged by means of the lever *D*.

In raising the rail, it can be brought to the desired height and stopped. In lowering, however, it should be lowered below the desired point and re-raised to the correct elevation in order to take up the lost motion in the elevating screws and nuts. While this will actually make a slight difference in the time for raising or lowering the rail through a given distance, the difference is so small that for all practical purposes the time for raising or lowering may be considered the same.

Table 2—Detailed Time for Preparation

Preparation of Machine for Work

Operation: Raise and lower rail by power.
Size of machine: 42, 60 and 84 inches.
Tools required: Open-end wrench.
Starting position of operator: In front of machine.

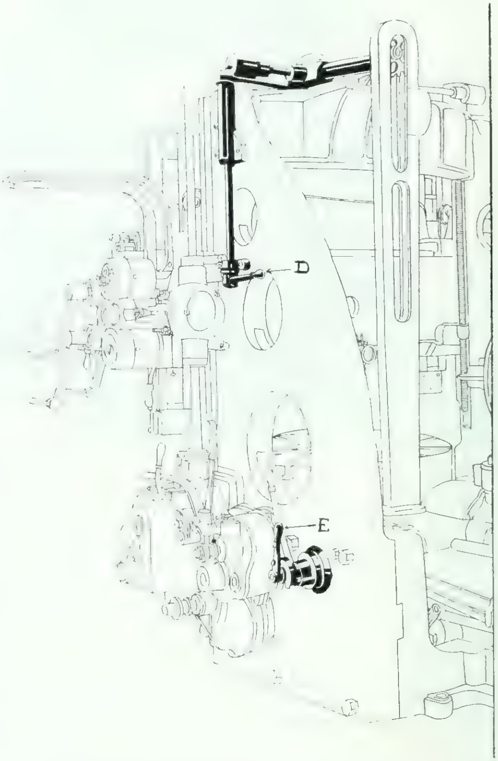
Details of operation	Size of Machine, Inches 42	60	84
Preparation for moving rail	Time in minutes		
1. Get wrench from tool stand......	0.0425	0.055	0.070
2. Walk to left side of machine	0.0700	0.080	0.100
3. Loosen clamping screws	0.1700	0.360	0.285
4. Walk to right side of machine.	0.0920	0.105	0.125
5. Loosen clamping screws	0.1700	0.270	0.285
6. Lay down wrench	0.0200	0.020	0.020
7. Engage clutch to operate chain	0.0500	0.050	0.050
8. Engage clutch to move rail	0.0400	0.040	0.040
Total preparation for moving	**0.65**	**0.98**	**0.98**
9. Move rail.		See	Table 13
10. Disengage elevating-chain clutch	0.040	0.040	0.040
11. Pick up wrench	0.050	0.056	0.065
12. Tighten clamping screws, right side	0.255	0.405	0.427
13. Walk to left side of machine.......	0.092	0.105	0.125
14. Tighten clamping screws, left side	0.255	0.540	0.427
15. Remove wrench to tool stand......	0.090	0.100	0.120
16. Return to front of machine .	0.040	0.055	0.070
Total time for clamping rail after moving................	**0.82**	**1.30**	**1.27**

The arrangement of the tables is uniform although the number of sizes of machines for which information is given is not necessarily the same. For example, Table 6 covers the full range of machines from the 30- to the 84-inch sizes. Table 7 covers the three larger only 42-, 60- and 84-inch, while Table 8 includes the two smaller and the intermediate size, that is the 30, 36- and 42-inch.

Table 3—Total Time for Moving Rail

Distance through which rail is moved.........	5 in.	10 in.	15 in.	20 in.	25 in.	30 in.
	42-Inch Boring Mill Time in Minutes					
1. Prepare to move rail (Table 2)............	0.6545	0.5645	0.6545	0.6545		
2. Move rail	0.1740	0.3480	0.5220	0.6960		
3. Clamp rail (Table 2).	0.8220	0.8220	0.8220	0.8220		
Total time for moving rail	**1.65**	**1.73**	**2.00**	**2.17**		

Mention has previously been made of the fact that in the practical use of the times given in the tables two decimal places are sufficient. For that reason the totals given in heavier type at the bottom of each table are only carried to two places of decimals. In case the figure in the third place was 5 or more, the second place was increased by one unit. If, however, the third place was 4 or less, it was disregarded.



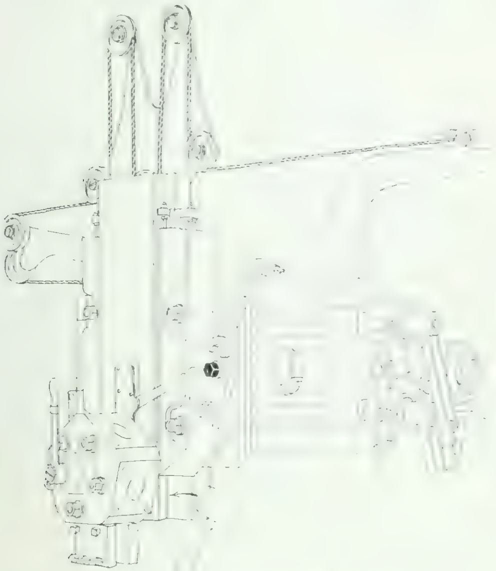
Swivel Head to an Angle

On 42-inch machines and larger the head is swiveled by means of a worm operated by an open-end wrench at *B*—See sketch with Table 4-B—after loosening nuts *A*, and can be moved exactly to the desired angle. On the 30- and 36-inch machines the worm is absent, and the

Table 4—Total Time for Moving Rail

	60-Inch Boring Mill					
1. Prepare to move rail (Table 1)............	0.980	0.980	0.980	0.980		
2. Move rail	0.694	1.390	2.083	2.780		
3. Clamp rail (Table 1).	1.301	1.301	1.301	1.301		
Total time for moving rail...............	**2.98**	**3.67**	**4.36**	**5.06**		
	84-Inch Boring Mill					
1. Prepare to move rail (Table 1)...........	0.975	0.975	0.975	0.975	0.975	0.975
2. Move rail...........	0.800	1.600	2.400	3.200	4.000	4.800
3. Clamp rail (Table 1)..	1.274	1.274	1.274	1.274	1.274	1.274
Total time for moving rail	**3.05**	**3.85**	**4.65**	**5.45**	**6.25**	**7.05**

head is swiveled by hand to approximately the desired angle and clamped loosely in position. Then by tapping the head one way or the other with a lead hammer or mallet it is adjusted exactly to the proper angle. The clamping nuts are then screwed home.



SWIVEL HEAD, 30 AND 36-INCH MACHINES

The complete operation of swiveling the head divides into the fundamental operations of loosening, swiveling and clamping. The details of loosening and clamping are given in Tables 4-A and 4-B respectively for machines up to and including 36-inch, and for 42-inch and larger. The complete time for the operation of swiveling is given in Tables 5-A and 5-B for the smaller and larger sizes, respectively.

For convenience in referring to the tables, the items arranged under the head "Details of Operation" are numbered consecutively beginning with one.

Remove and Replace Tool Post of Bar on Turret Head or Ram

The tool posts in the larger sizes of Gisholt boring mills may be carried either in the ram or the turret head on the ram. In the smaller sizes—30- and 36-inch mills—only the turret head is available.

The tool post or bar is removed from the turret head by loosening a single hexagon clamping bolt in the head, which allows the bar or post to drop out. The workman, while loosening the clamping bolt, holds the bar or post with his free hand to prevent it from falling to the table. After loosening the bolt, the bar or post is grasped with both hands, lifted out of the head and removed to a convenient position on the floor alongside the tool stand. The table assumes that the bar or post that is to replace the one removed is at hand on the floor or tool stand and that it is procured and carried to the machine on the return trip, after disposing of the first post or bar. It is placed in the turret head and held in position with one hand, while with a wrench in his free hand the workman tightens the clamping nut

The process of removing and replacing the tool post or bar in the ram is the same as removing or replacing it in the turret heads, except that there are three clamping bolts to be manipulated and a locking pin to be pulled out. The purpose of this pin is to prevent the bar or post from falling to the table when the clamping bolts are loosened. The workman holds the bar with his free hand while he releases the locking pin and then uses both hands to remove the bar.

TABLE 4A

Loosen and Clamp Head—30 and 36-Inch Machines

Details of operation	Size of Machine, Inches	
	30	36
Loosen head	Time in minutes	
1. Obtain wrench and lead hammer from tool stand	0.055	0.06
2. Loosen hexagon clamping nuts..............	0.280	0.42
3. Lay wrench on table of machine	0.020	0.02
Total time for loosening head	**0.36**	**0.50**
4. Swivel head to or from zero	...See Table 4-A	
Clamp head		
5. Exchange lead hammer for wrench...........	0.03	0.03
6. Tighten firmly nuts on right side of head.....	0.14	0.21
7. Tighten firmly nuts on left side of head.....	0.20	0.30
8. Remove wrench and hammer to tool stand....	0.055	0.06
Total clamping time	**0.43**	**0.60**

TABLE 4B

Total Time to Loosen and Swivel Head and Clamp

Swivel Head to Angle

Tools required: Lead hammer or mallet, clamping wrench.
Normal position of workman: In front of machine.
Normal condition of machine: Head at right angles to rail.

Degrees of swivel.......	5	10	15	20	25	30
	30-Inch Machine Time in Minutes					
Loosen head (Table 4-A)	.355	.355	.355	.355	.355	.355
Swivel head..........	.19	.21	.225	.24	.25	.27
Clamp head (Table 4-A)	.425	.425	.425	.425	.425	.425
Total time for swivling head	**0.97**	**0.99**	**1.01**	**1.02**	**1.03**	**1.05**
	36-Inch Machine					
Loosen head (Table 4-A)	.50	.50	.50	.50	.50	.50
Swivel head	.20	.22	.23	.25	.26	.28
Clamp head (Table 4-A)	.60	.60	.60	.60	.60	.60
Total time for swiveling head	**1.30**	**1.32**	**1.33**	**1.35**	**1.36**	**1.38**

Changing Position of Tool Post in Ram

The position of the tool post as regards its distance from the base of the ram can be varied by locating the locking pin in any one of three slots in the tool post head. To change the position of the tool post, the three clamping bolts are loosened, and the locking pin is pulled out. The workman, meanwhile, with his free hand grasps the tool post and raises or lowers it to its new position and releases the pin. The clamping bolts are then tightened.

Setting Chuck Jaws and Drivers

Work is commonly held on the table of boring mills by means of chuck jaws fitted to the slots in the table, by clamping it on parallels on the table, by setting it in drivers, or by clamping it flat upon the table.

TABLE 5A

Loosen and Clamp Head—42 to 84-Inch Machines

	42 Inch	60 Inch	84 Inch
Obtain two wrenches from stand	0.06	0.07	0.09
Loosen clamping nuts	0.28	0.28	0.42
Lay wrench on table	0.02	0.02	0.02
Pick up worm-operating wrench	0.03	0.03	0.03
Total time to loosen head	**0.39**	**0.40**	**0.56**
Swivel head to or from zero	See Table 4-B		
Lay down worm-operating wrench	0.02	0.02	0.02
Pick up clamping wrench........ ..	0.03	0.03	0.03
Tighten clamping nuts........	0.40	0.40	0.60
Remove wrenches to tool stand .	0.06	0.07	0.09
Total time to clamp head	**0.51**	**0.52**	**0.71**

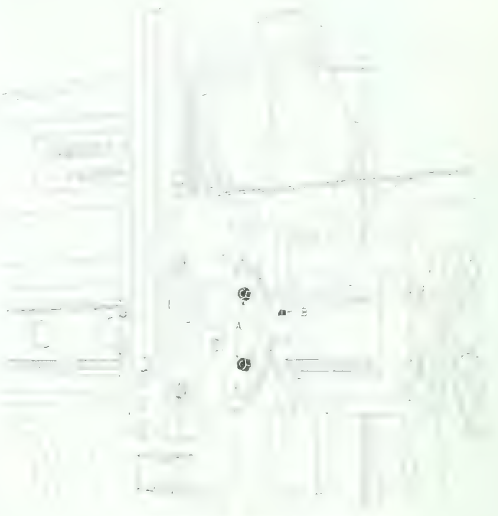
TABLE 5B

Total Time to Loosen Swivel Head and Clamp

Degrees	5	10	15	20	25	30	35	40	45
				42-Inch Machine					
Loosen head (Table 5-A)	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Swivel head..........	0.37	0.45	0.54	0.64	0.75	0.86	0.97	1.09	12.2
Clamp head (Table 5-A)	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
Total time for swiveling head	**1.27**	**1.35**	**1.44**	**1.54**	**1.65**	**1.76**	**1.87**	**1.99**	**2.12**
				60-Inch Machine					
Loosen head (Table 5-A)	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Swivel head	0.43	0.51	0.61	0.71	0.82	0.93	1.05	1.17	1.30
Clamp head (Table 5-A)	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Total time for swiveling head	**1.35**	**1.43**	**1.53**	**1.63**	**1.74**	**1.85**	**1.97**	**2.09**	**2.22**
				84-Inch Machine					
Loosen head (Table 5-A)	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Swivel head	0.48	0.57	0.67	0.76	0.89	1.00	1.12	1.25	1.40
Clamp head (Table 5-A)	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Total time for swiveling head	**1.78**	**1.87**	**1.97**	**2.06**	**2.19**	**2.30**	**2.42**	**2.55**	**2.70**

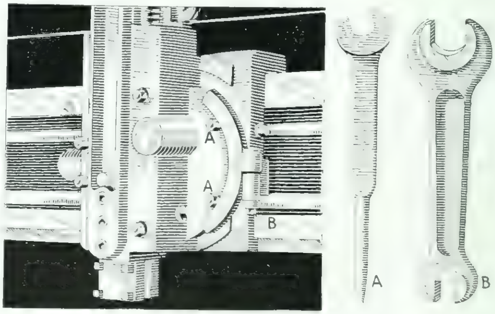
Chuck jaws. Boring mills up to and including 42-inch have a table consisting of a three-jaw scroll chuck, the jaws having both independent and universal movements. Machines larger than 42-inch have four detachable independent chuck jaws mounted on bases held to the table by means of four T-slot bolts in parallel T-slots on the table. Each jaw is moved with reference to its base by a screw operated by a socket wrench, as at *A* in sketch of Tables 8 and 9. The time-study tables assume that the T-slot bolts are kept in the holes in the base.

The jaws of the three-jaw chucks are set to that line on the table which most nearly corresponds to the diameter of the work. They are then caused to grip the work by means of the scroll movement. See *B* sketch of Tables 8 and 9. The base of the independent jaw for machines larger than 42-inches is placed with its outer edge flush with the edge of the table, and the jaw is moved backward and forward in the base by means of the screw until it attains its approximate desired position with reference to the base. The base is then moved forward on the table to the line most nearly corresponding to the diameter of the work and is clamped down to the table. The operations are repeated for the second jaw before moving the table. The final adjustment of the jaws is made independently after the work is in place.



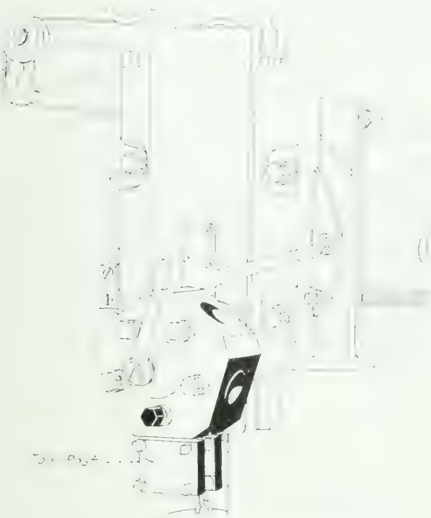
SWIVEL HEAD—42, 60 AND 84-INCH MILLS

When reversing the chuck jaws on the table, as is necessary for certain classes of work, the clamping bolts at *C*, Sketch with Tables 8 and 9 are loosened, the jaws removed from the table, turned end for end and entered in the table slots. From this point the process is the same as for setting the jaws for the first time. In the case of independent jaws for machines larger than 42-inch, adjustment of the jaw is, as above, made with the base flush with the edge of the table.



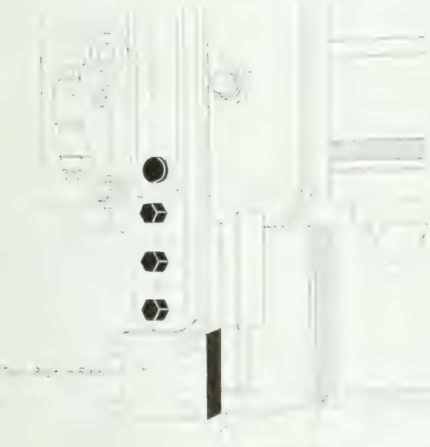
DETAIL OF OPERATION ON SWIVEL HEAD

In moving the chuck jaws on the table without reversing them it is necessary in the case of the jaws having bases, first to remove the base of the jaw until its edge is flush with the edge of the table and then to adjust the jaw to the size of the piece, after which the base and jaw are moved forward to the desired location.



OPERATION TO REMOVE TOOL POST

The tables assume that the workman first measures the diameter of the piece to be machined and sets his chuck jaws so that the work may be gripped by them with a miuimum movement of the jaws. The tables also assume that the work is piled on the floor about six feet distant from the machine.



OPERATION TO LOWER TOOL POST

The line drawings used to call attention to specific operations in connection with many of the tables are located close to the table or tables which they assist in explaining. For instance, Table 7 gives times for raising or lowering the tool post in the ram. The illustration accompanying Table 7 shows in outline a part of one of the boring mill heads with the tool post shaded to make it more prominent, and with the head of the pull pin and the heads of the three clamping bolts outlined in black to make them prominent, and so call attention to the operation covered by the table.

TABLE 6

REMOVE AND REPLACE TOOL POST OR BAR

PREPARATION OF THE MACHINE FOR WORK

Operation: Remove and replace tool post or bar from turret head or ram.
Tool required: Open-end wrench.
Normal position of workman: In front of machine.
Normal condition of machine: Tool post or bar in head or ram.

Details of operation	Size of Machine, Inches					
	30	36	42	42	60	84
	Time in Minutes					
1. Obtain wrench from tool stand, walk to left side of machine....	0.09	0.10	0.10	0.10	0.13	0.16
2. Loosen hexagon clamping bolts...	0.07	0.07	0.07	0.12	0.17	0.20
3. Lay wrench on table............	0.02	0.02	0.02	0.02	0.02	0.02
4. Remove post or bar from turret..	0.03	0.03	0.03			
5. Pull pin and remove post or bar from ram....................				0.06	0.09	0.12
6. Remove post or bar to floor	0.05	0.05	0.07	0.07	0.08	0.09
7. Carry bar or post to machine.....	0.08	0.08	0.09	0.09	0.12	0.14
8. Put bar or post in turret........	0.04	0.04	0.04			
9. Put bar or post in ram				0.15	0.17	0.20
10. Pick up wrench................	0.02	0.02	0.02	0.02	0.02	0.02
11. Tighten hexagon clamping bolts	0.12	0.12	0.12	0.22	0.26	0.29
12. Return wrench to tool stand......	0.07	0.07	0.08	0.08	0.09	0.11
Total time to remove and replace tool post or bar	**0.59**	**0.60**	**0.61**	**0.93**	**1.15**	**1.35**

TABLE 7

RAISE OR LOWER TOOL POST IN RAM

PREPARATION OF THE MACHINE FOR WORK

Operation: Raise or lower tool post in ram.
Tool required: Open-end wrench.
Normal position of workman: In front of machine.

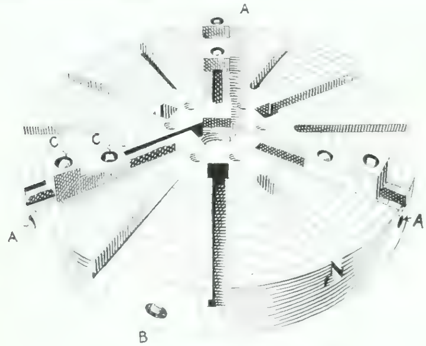
Details of operation	Raise Post			Lower Post		
	Size of Machine Inches			Size of Machine Inches		
	42	60	84	42	60	84
	Time in Minutes					
1. Obtain wrench from tool stand, walk to left side of machine..........	0.09	0.09	0.10	0.09	0.09	0.10
2. Loosen hexagon clamping bolt....	0.12	0.17	0.20	0.12	0.17	0.20
3. Lay wrench on table	0.02	0.02	0.02	0.02	0.02	0.02
4. Pull pin, raise post	0.04	0.05	0.05			
5. Pull pin, lower post..				0.08	0.09	0.09
6. Pick up wrench.........	0.02	0.02	0.02	0.02	0.02	1.02
7. Tighten clamping bolts....	0.22	0.26	0.29	0.22	0.26	0.29
8. Remove wrench to stand	0.08	0.09	0.11	0.08	0.09	0.11
Total time to raise post.	**0.59**	**0.70**	**0.79**			
Total time to lower post..				**0.63**	**0.74**	**0.83**

In a similar way the two styles of chucks used on the boring mills studied are shown in the line engravings accompanying Tables 8 and 9 and 12 and 13. The first is the regular Gisholt universal scroll chuck, while the

TABLE 8

Set Chuck Jaws to Line—30- to 42-Inch Mills
Preparation of Machine for Work
Operation: Setting chuck jaws on table.
Size of machine: 30, 36 and 42 inches.
Tools required: 6-foot rule; chuck wrench.
Table clear at beginning of job.

Details of operation	Size of Machine, Inches		
	30	36	42
	Time in Minutes		
1. Obtain rule, measure diameter of piece	0.120	0.120	0.120
2. Obtain chuck wrench from stand....	0.035	0.040	0.045
3. Pick up chuck jaw	0.050	0.060	0.070
4. Insert jaw in table slot; move jaw to line....................	0.087	0.093	0.100
5. Tighten two screws in jaw	0.210	0.220	0.230
6. Turn table 120 degrees...	0.090	0.100	0.120
7. Repeat items 3, 4 and 5	0.347	0.373	0.400
8. Turn table 120 degrees........	0.090	0.100	0.120
9. Repeat items 3, 4 and 5	0.347	0.373	0.400
10. Remove wrench to stand	0.035	0.040	0.045
Total time for setting three chuck jaws	**1.11**	**1.52**	**1.65**



THREE-JAW CHUCK FOR BORING MILL

TABLE 9

Remove Jaws from Table—30- to 42-Inch Mills

Details of operation	Size of Machine, Inches		
	30	36	42
	Time in Minutes		
1. Obtain chuck wrench from stand	0.035	0.040	0.045
2. Loosen two screws in jaw.........	0.172	0.180	0.190
3. Remove jaw from slot to stand	0.040	0.050	0.060
4. Turn table 120 degrees......	0.090	0.100	0.120
5. Repeat items 2, 3 and 4.......	0.302	0.330	0.370
6. Repeat items 2 and 3	0.212	0.230	0.250
7. Remove wrench to stand	0.035	0.040	0.045
Total time for removing three chuck jaws	**0.89**	**0.97**	**1.08**

second shows the use of four independent jaws which can be set to accommodate work of any desired diameter within the range of the boring mill table. The rough adjustment of these jaws is made to the circular lines scribed on the table, but the finer adjustments, together with the movement necessary to clamp the work, are by means of a screw in the jaw itself.

REVERSING JAWS ON TABLE

TABLE 10

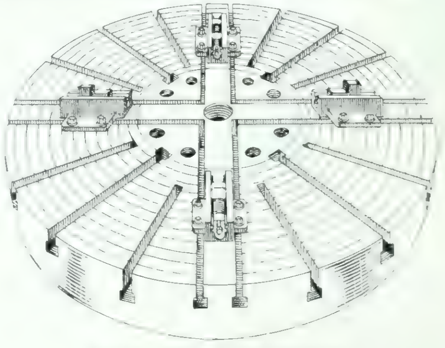
Reversing Jaws of 30- to 42-Inch Mills, Jaws on Table at Beginning of Job

Details of operation	Size of Machine, Inches		
	30	36	42
	Time in Minutes		
1. Obtain rule, measure diameter of piece	0.120	0.120	0.120
2. Obtain chuck wrench from tool stand	0.035	0.040	0.045
3. Loosen two clamping screws on jaw.	0.172	0.180	0.190
4. Remove jaw from slot............	0.050	0.055	0.060
5. Reverse jaw, enter in slot to line...	0.089	0.093	0.100
6. Tighten two clamping screws on jaw	0.210	0.220	0.230
7. Turn table 120 degrees..........	0.090	0.100	0.120
8. Repeat items 3, 4, 5 and 6.	0.521	0.548	0.580
9. Turn table 120 degrees...	0.090	0.100	0.120
10. Repeat items 3, 4, 5 and 6........	0.521	0.548	0.580
11. Remove wrench to stand	0.035	0.040	0.045
Total time for removing three jaws	**1.93**	**2.04**	**2.19**

TABLE 11

Moving Jaws In or Out to Line—30-, 36- and 42-Inch Mills—Jaws on Table at Beginning of Job

Details of operation	Size of Machine, Inches		
	30	36	42
	Time in Minutes		
1. Obtain rule, measure diameter of piece	0.120	0.120	0.120
2. Obtain chuck wrench from tool stand	0.035	0.040	0.045
3. Loosen two clamping screws in jaw..	0.172	0.180	0.190
4. Move jaw up to line	0.080	0.093	0.100
5. Tighten two clamping screws on jaw.	0.210	0.220	0.230
6. Turn table 120 degrees...........	0.090	0.100	0.120
7. Repeat items 3, 4 and 5..........	0.471	0.493	0.520
8. Turn table 120 degrees..........	0.090	0.100	0.120
9. Repeat items 3, 4 and 5...........	0.471	0.493	0.520
10. Remove chuck wrench to tool stand	0.035	0.040	0.045
Total time for moving three jaws	**1.78**	**1.88**	**2.01**



FOUR-JAW CHUCK FOR BORING MILL

PREPARATION OF MACHINE FOR WORK

Size of machine: 60- to 84-inch.
Operation: Setting chuck jaws on table.
Tools required: 6-foot rule; chuck wrench; four chuck jaws.

TABLE 12

SET CHUCK JAWS TO LINE

Details of operation	Size of Machine Inches	
	60	84
	Time in Minutes	
1. Obtain rule, measure diameter of piece	0.150	
2. Obtain chuck wrench from stand	0.055	
3. Pick up chuck jaw from stand	0.110	
4. Enter slot bolt in base into table slot, on the edge flush with table	0.120	
5. Screw jaws in base to suit diameter of work	0.270	
6. Move jaw base up to line	0.160	
7. Tighten 4 ⅞-inch clamp bolts	0.440	
8. Repeat items 3 to 7 inclusive	1.100	
9. Turn table 180 degrees	0.180	
10. Repeat twice items 3 to 7 inclusive	2.200	
11. Remove chuck wrench to stand	0.060	
Total time for setting four chuck jaws	4.85	

TABLE 13

REMOVE JAWS FROM TABLE

Details of operation	Size of Machine Inches	
	60	84
	Time in Minutes	
1. Obtain chuck wrench from stand	0.055	
2. Loosen four clamping bolts	0.440	
3. Remove jaw from slot to floor	0.160	
4. Repeat items 2 and 3	0.600	
5. Turn table 180 degrees	0.180	
6. Repeat twice items 2 and 3	1.200	
7. Remove wrench to stand	0.055	
Total time for removing four chuck jaws	2.69	

TABLE 14

REVERSING JAWS IN 60- AND 84-INCH MILLS

Details of operation	Size of Machine Inches	
	60	84
	Time in Minutes	
1. Obtain rule, measure diameter of piece	0.150	
2. Obtain chuck wrench from stand	0.055	
3. Loosen four clamping bolts on jaw	0.440	
4. Remove jaw from slot	0.070	
5. Reverse jaw	0.060	
6. Enter base in table slot, outer edge flush with table	0.120	
7. Screw jaw in base to suit diameter of work	0.270	
8. Move jaw base to line	0.160	
9. Tighten four clamping bolts on jaw	0.440	
10. Repeat items 3, 4, 5, 6, 7, 8 and 9	1.560	
11. Turn table 180 degrees	0.180	
12. Repeat twice items 3, 4, 5, 6, 7, 8 and 9	3.120	
13. Remove wrench to tool stand	0.055	
Total time for reversing four jaws	6.68	

TABLE 15

MOVING JAWS IN OR OUT TO LINE 60- AND 84-INCH MILLS

Details of operation	Size of Machine, Inches	
	60	84
	Time in Minutes	
1. Obtain rule, measure diameter of piece	0.150	
2. Obtain chuck wrench from tool stand	0.055	
3. Loosen four clamping bolts in jaw	0.440	
4. Move jaw base back, edge flush with table	0.070	
5. Screw jaw in base to suit diameter of work	0.270	
6. Move jaw to line	0.160	
7. Tighten four clamping bolts in jaw	0.440	
8. Repeat items 3, 4, 5, 6 and 7	1.380	
9. Turn table 180 degrees	0.180	
10. Repeat twice items 3, 4, 5, 6 and 7	2.760	
11. Remove chuck wrench to tool stand	0.055	
Total time for moving four jaws	5.96	

(To be continued)

How to Prevent Car Demurrage—Discussion

Editor, INDUSTRIAL MANAGEMENT:—

After reading the article "How to Prevent Car Demurrage" in your May issue by Mr. Farnham, there are one or two questions which I wish to refer to which may be of some assistance in preventing demurrage and releasing cars more quickly.

In Mr. Farnham's list of fundamentals he refers to the car that has been in the yard the longest which should be taken care of first, etc. We cannot agree with Mr. Farnham in all cases. We had in mind our own conditions in which oftentimes there are from fifty to sixty cars of pulpwood in the yards at one time. If we should ask that the oldest cars be taken care of first it would require from an hour or two to switch out these older cars in preference to new loads or those first out. This would also delay the unloading as the switching crew would be delayed in arriving at our plant on their schedule time, and most likely, our crew would be waiting for the loaded cars.

In the majority of places where the cars are reported at some specified time each day by the railroad company we find that we have increased our unloading efficiency by a large percentage, by arranging with the railroad company to report the cars arriving at intervals of two or three hours during the day. For instance, if the understanding was to receive the report but once a day, at 8 in the morning and a quantity of cars should arrive early in the afternoon, we would not know of their arrival until the following morning, whereas if they report immediately when they arrive we could immediately give our orders as to where they should be delivered and in most cases these cars would be delivered to our platforms the same day they were received by the railroad company.

Yours very truly,

HARRY BALLOU,

Menasha Paper Company

How to Move Materials by Machinery

To Release Labor and Keep Freight Cars Moving, Machinery Must Be Used to Load, Unload and Transport Materials

By Henry J. Edsall

The author shows the application of various types of elevating and conveying machinery to the handling of coal, crushed stone, sand, coke, cement in bags, barrels and vegetables in a canning establishment. A feature in each case is a per hour capacity of the device illustrated. The importance of such information at present can hardly be overestimated, for conveying machinery must be used in all kinds of industrial plants if we are to reach the needful rate of production.

Mr. Henry J. Edsall *after completing his engineering education entered the engine erecting shops at Cramp's shipyards. After nine months in that position he spent about 1½ years in several drafting rooms and finally entered the employ of the Link-Belt Company as draftsman. Two years later he went to the New York office as estimator and salesman. At the end of three years he returned to the Philadelphia office of the Link-Belt Company and is now in the contract department.*

TWO of the most important problems during these war times are labor shortage and car shortage. Both of these deficiencies work in the same direction, for the increasing lack of unskilled labor tends to increase the car shortage, and the car shortage boosts the demand for labor—and the increasing cost of handling materials makes the improvement of handling facilities imperative.

A great deal has been heard of late about using machinery in place of men, and probably no class of work presents such a necessity and such economic possibilities as the handling and transportation of bulk materials and articles of all sorts used in industry.

It is imperative, also, that all delays to cars shall be reduced to a minimum, and to accomplish this the Government must have the whole hearted coöperation of the shipper and consignee and facilities must be provided for expediting loading and unloading at shipping and receiving points. The resultant savings in labor costs and in the elimination of demurrage charges will be money in the pocket of the shipper or consignee, and the reduction in the idle time of the railroad cars will be to the benefit of the country at large and will of course help to win the war.

The Problem of Handling Coal

As a first example, take the commodity coal which is of prime importance, not only on account of the great amount to be handled and the almost universal use, but on account of its being the most important factor in keeping the wheels of industry turning. The railroads have provided coal-carrying cars of special design, most of which are equipped with bottom doors to expedite discharging in an efficient and economical manner. These cars are loaded quickly and with little labor at mines and shipping points. They are then distributed to the consumer or dealer and the responsibility for keeping them moving is temporarily shifted from the railroads to the consignee. If the consignee is a large user he is likely to have more or less efficient facilities for unloading them quickly and returning them to the railroad; otherwise he is wasting considerable money in labor costs and demurrage charges.

While the economies of proper unloading facilities may be very patent to the one handling large

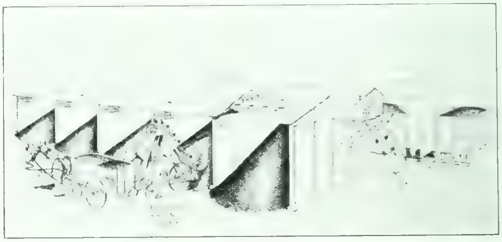


FIG. 1. ARRANGEMENT OF ELEVATOR AND CONVEYOR FOR COAL STORAGE

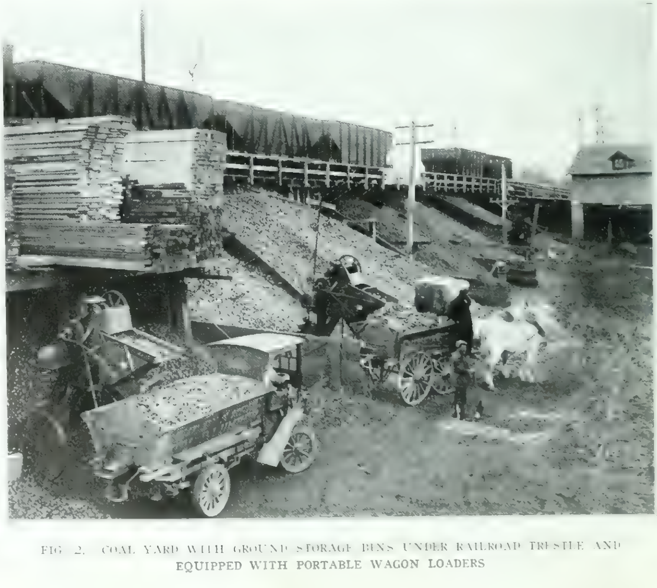


FIG. 2. COAL YARD WITH GROUND STORAGE BINS UNDER RAILROAD TRESTLE AND EQUIPPED WITH PORTABLE WAGON LOADERS

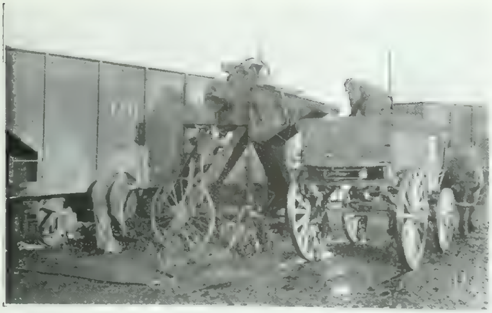


FIG. 3. PORTABLE WAGON LOADER HANDLING COAL DIRECT FROM CARS TO WAGONS

amounts, the one who handles small amounts is not so sure about them and very likely has put off investigating the possibilities. He has always been able to get men to shovel and wheel coal, and while he may have realized that his handling costs were rather excessive, there have been many other demands for his capital and he has been more or less skeptical about the return to be obtained on an investment in improved handling facilities.

Now that labor is so hard to get and so expensive, and the demands for keeping the cars moving so insistent, he is having the errors of his ways driven home to him and is beginning to realize that it is up to him to reduce his labor costs, arrange to get along with a minimum amount of help, and keep the cars moving.

Since, as stated above, the large handler usually has more or less complete facilities, the possibilities of improvement will be confined in this article largely to the consumer or dealer who does not handle large amounts. When the consignee is a coal dealer the problem of unloading the coal has to do with several different kinds and sizes, and a large percentage of what is received has to be stored for future delivery. The unloading and storing of the coal is usually a minor part of the handling expense, since this is overshadowed by the cost of loading in wagons or trucks and delivering to the consumer. In providing facilities for handling, therefore, the dealer must take into consideration the unloading of the cars or boats, the providing of proper storage facilities and the rehandling and delivery to the consumer.

When coal is shipped direct to a consumer it is ordinarily for use in a boiler room or gas plant, or for coaling locomotives. There is likely to be only one kind of coal handled, and it is unloaded as close to the point of consumption or distribution as possible. More or less storage is provided for, usually an active storage in overhead bins for gravity delivery to consuming units, and a reserve storage of larger capacity to act as an insurance against lack of fuel during the times when shipments are not being received and to make it possible to purchase at the most advantageous times. These storage facilities also serve as equalizers of the varying conditions of supply and demand and thereby help to keep the output of the mines more uniform and to avoid excessive demands at certain seasons.

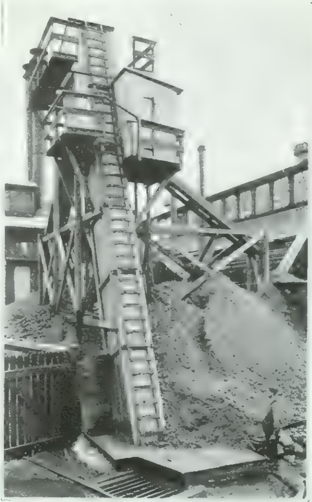


FIG. 4. SIMPLE CHAIN AND BUCKET ELEVATOR FOR UNLOADING COAL FROM CARS AND PILING IT NEAR BOILER ROOM

METHODS OF UNLOADING COAL

The crudest way of unloading coal from cars is to shovel it out. This, is of course, a slow and expensive method, especially with the modern coal cars with their high sides and with the present high cost of labor. Another method is to build a trestle so that the coal can be dumped through the bottom doors and stored in the space underneath the trestle.

A third method is to discharge the coal through the bottom doors into a pit or hopper, from which it is removed by mechanical means and delivered to bins, to ground storage, or possibly direct to the points of consumption.

In many cases the trestle scheme works out well for the coal dealer, since it is easy to divide the space underneath the trestle into a number of bins for the different kinds and sizes. It provides, however, only for the unloading of the coal from the cars, not for the loading to wagons or trucks, unless the trestle is built very high and has overhead bins. In addition to this, a trestle of heavy construction to

[illegible] COAL FROM CARS TO PILE AGAINST [illegible] BOILER ROOM

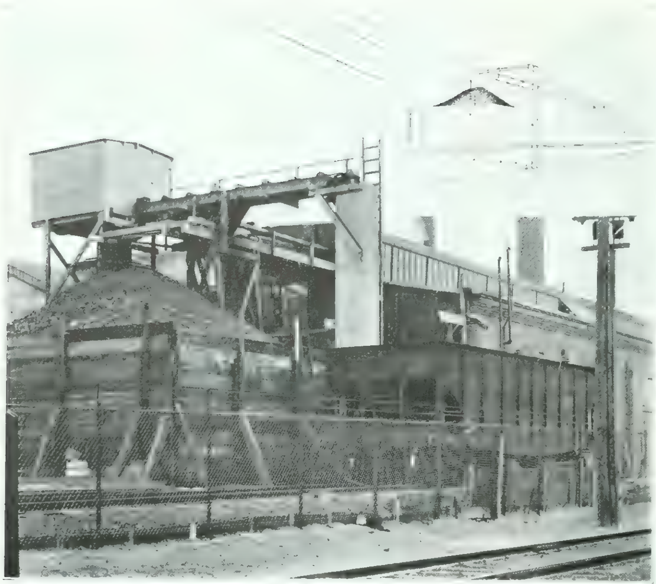


FIG. 6. GRAVITY DISCHARGE ELEVATOR AND FLIGHT CONVEYOR EQUIPMENT FOR HANDLING COAL DIRECT TO BOILER ROOM, OR FOR STORING IN A PIT IN THE YARD

support railroad cars is quite expensive and, unless the contour of the ground makes it unnecessary, a long and costly approach is required. Wooden trestles, while cheaper in first cost, are increasingly expensive in maintenance on account of the deterioration in the quality of lumber obtainable.

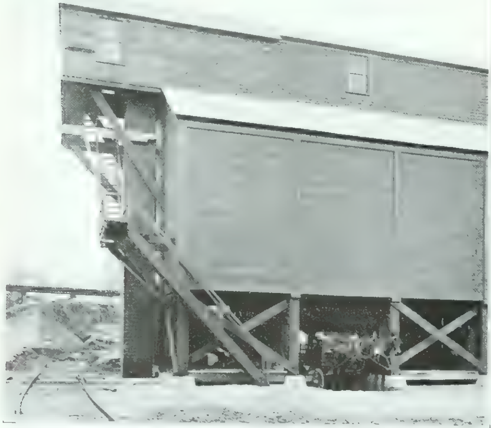


FIG. 7. COAL POCKET WITH COAL HANDLED TO OVERHEAD BIN BY MECHANICAL MEANS AND ARRANGED FOR GRAVITY DELIVERY TO WAGONS WITH AN AUTOMATIC SCREENING FEATURE

Where ground bins are used, it is cheaper and better to keep the siding at ground level and employ conveyors, with their comparatively light supporting structure, to handle the coal to the bins as shown in Figure 1. With these the coal is dumped from the cars into a pit under the track, from which it feeds to a chain and bucket elevator that takes it up and delivers it to a distributing flight or scraper conveyor over the bins, with one or more discharge gates at each bin. The conveyors can be driven by a small electric motor or engine at a small cost for power, ordinarily less than one cent per ton handled. The unloading machinery handles coal at the rate of about 40 tons per hour, and the wagon loader loads it in wagons at the rate of about 30 tons per hour.

For the dealer who stores his coal on the ground, either under a railroad trestle or piled by conveyors, the cost of loading to wagons can be reduced to a minimum by the use of a mechanical wagon loader which is simply a small chain and bucket elevator on wheels. This machine requires a certain amount of manual labor in feeding the coal at the foot but it handles it rapidly and screens it automatically so that two operations are reduced to one, and the idle time of teams and drivers in the yard is greatly reduced. Figure 2 shows a railroad trestle yard equipped with wagon loaders. These machines will load coal at a rate of one-half ton to one ton per minute and are usually driven by a three or five horsepower electric motor or gasoline engine. The cost for the sizes ordinarily used is somewhere between $500 and $1000 complete. They can also be used for handling coal directly from a car, as it flows out from the bottom doors, to a wagon or truck or to a pile or ground bin along a ground level siding. A machine at work in this way is shown in Figure 3. These machines are also used for loading sand, crushed stone, coke, fertilizer, etc.

For a consumer the trestle scheme does not work out so well. When coal is distributed along under a trestle it means that it is piled in a long narrow pile, and when it is to supply a boiler it is necessary to collect it from this long pile, an operation that necessitates considerable labor and is especially objectionable in bad weather.

When mechanical means are employed the coal can be concentrated in a pile close to the boiler room, or deliv-

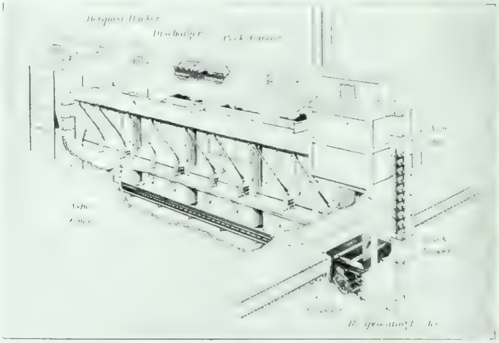


FIG. 8. ARRANGEMENT OF BOILER HOUSE WITH PIVOTED BUCKET CARRIER FOR COAL AND ASHES; OVERHEAD COAL BIN WITH SPOUTS TO STOKERS; AND OVERHEAD ASHES BIN FOR DELIVERING ASHES TO RAILROAD CARS

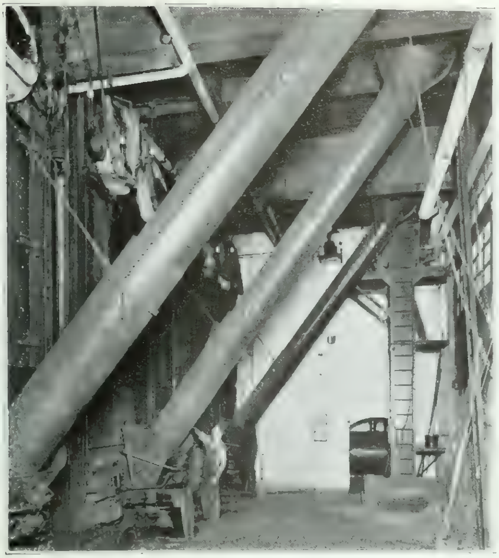


FIG. 9. BOILER ROOM WITH MECHANICAL STOKERS, BUT NOT ARRANGED FOR GRAVITY DELIVERY TO STOKERS

cred to an overhead bin in the boiler room, or just outside, and the labor for delivering it to the furnaces is reduced to a minimum. If mechanical stokers are used it can be spouted from an overhead bin directly to the stoker magazine, or transferred by means of a conveyor or traveling lorry equipped, if desired, with scales for weighing. The supports for the mechanical equipment are comparatively light and the first cost and maintenance cost are correspondingly low.

When unloading from railroad cars by mechanical means the usual method is to build a hopper or pit under the track into which the coal can be dumped and then use a conveyor or grab bucket to transfer it from the pit to a pile or bin. Figure 4 shows an inclined chain and bucket elevator for this purpose, the coal being piled close to the boiler room so that it is convenient for the firemen. Where run-of-mine bituminous coal is handled a grating is frequently placed over the track hopper to keep out lumps too large to be conveniently handled by the buckets and these lumps are broken on the grating.

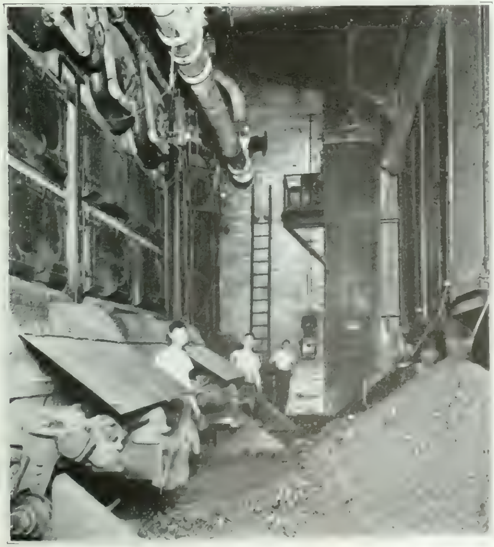


FIG. 10. BOILER ROOM [illegible] COAL IS DELIVERED [illegible]

The machinery for such an equipment, including a motor for operating, can be purchased for less than $1,000. It wil unload the coal at the rate of 25 or 30 tons per hour at a cost of two or three cents per ton for power and the labor of helping the coal out of the cars and breaking the larger lumps. Larger equipments can be installed if desired and they can be made to handle the lumps without breaking but this, of course, adds to the cost of the equipment, which may not be warranted.

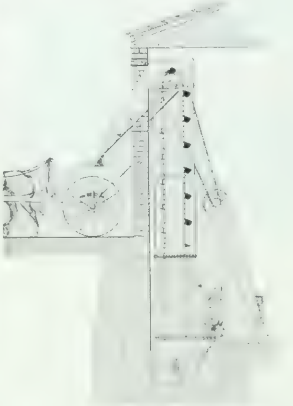


FIG. 11. STANDARD CHAIN AND BUCKET ASHES ELEVATOR

THE INCLINED FLIGHT CONVEYOR

Figure 5 shows an inclined flight conveyor instead of a chain and bucket elevator for unloading coal from cars. It has a capacity of 30 tons per hour. The coal is fed from the hopper under the track into a steel trough and is pushed up the trough by flights or pushers attached to an endless chain. The coal is piled directly against the boiler room wall and a certain percentage of it flows through openings in the wall and forms a pile on the floor directly in front of the boilers and thus within easy reach of the firemen.

[illegible] ELEVATOR [illegible] OVERHEAD BIN

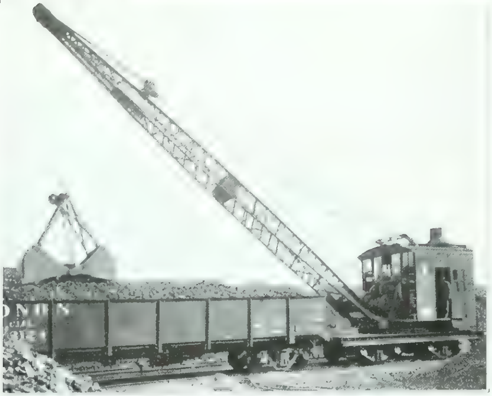


FIG. 13 LOCOMOTIVE CRANE EQUIPPED WITH SELF FILLING BUCKET FOR HANDLING COAL TO AND FROM OUTSIDE STORAGE PILES

Figure 6 shows a plant where a coal pile is formed by an elevator-conveyor at a little distance from the end of the boiler room, and where there is another conveyor running into the boiler room to take the coal in and deliver it to piles on the floor in front of the boilers. The first machine encircles the storage space, the lower run being in a concrete tunnel underneath, so that coal can be either handled directly from the cars to the flight conveyor to the boiler room or from cars to the storage pile. When it is taken from storage it is fed to the lower run of the first machine which elevates it and transfers it to the flight conveyor for delivery to the boiler room. Each machine has a capacity of 40 tons per hour.

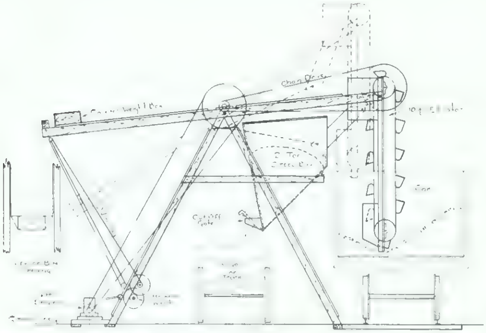


FIG. 14 ELEVATOR FOR UNLOADING SAND AND BROKEN STONE FROM RAILROAD CARS TO WAGONS

Figures 7 and 8 show still more elaborate labor-saving equipments. The former is a modern retail coal pocket. The coal is elevated by a bucket elevator and distributed by a flight conveyor into a number of overhead bins from which it can be drawn off by gravity to wagons and the screening automatically accomplished as it passes over the chutes with bottoms made of screen wire. With a plant of this kind the labor, both of unloading cars and of loading wagons or trucks, is reduced to a minimum and the coal is all stored under cover and delivered clean.

Figure 8 shows a boiler room with a complete coal and ash handling equipment, The coal is fed from the track hopper by means of an automatic feeder to a crusher and then to a pivoted bucket carrier which takes it up and distributes it in the overhead bin from which it feeds by gravity to the magazines of the mechanical stokers. The ashes are raked out of the pit under the furnaces and the same carrier takes them up to the overhead ash bin from which they are delivered by gravity to railroad cars.

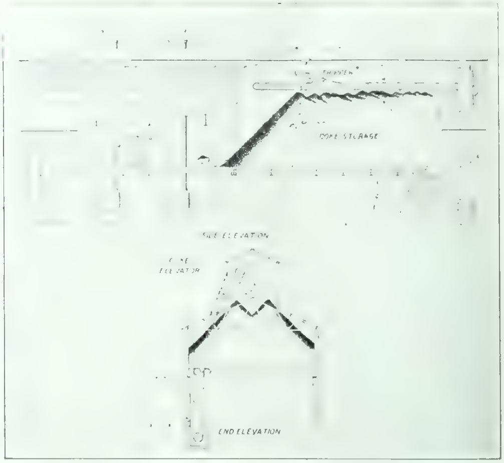


FIG. 15. COKE HANDLING EQUIPMENT FOR FOUNDRY

Figures 9 and 10 show two boiler room interiors, both plants being equipped with mechanical stokers. In the former the coal is broken by hand and shoveled to the stoker magazines; in the latter it is crushed mechanically and delivered by gravity to the magazines. The contrast is quite striking. The capacity of the plant of Figure 10 is 30 tons per hour.

A proper ashes handling equipment at a power plant not only saves labor but avoids dust and confusion and removes the most distasteful part of the fireman's job so that it is easier to get and hold a good man. Figure 11 shows a simple ash elevator having a capacity of 15 tons per hour, for handling ashes from a basement boiler room to carts or to a pile. While this is a great help in handling the ashes, there should really be an overhead storage bin provided so that the ashes can be sent up to the bin at once. Otherwise a second handling is necessary unless a cart is always standing ready to receive them. Figure 12 shows an equipment of this kind with a 5-ton steel bin. Larger bins are frequently made of concrete, or concrete and brick, and are arranged to deliver to railroad cars, carts or both. In small boiler rooms the ashes are usually handled in wheelbarrows to the elevator, but in larger plants a con-

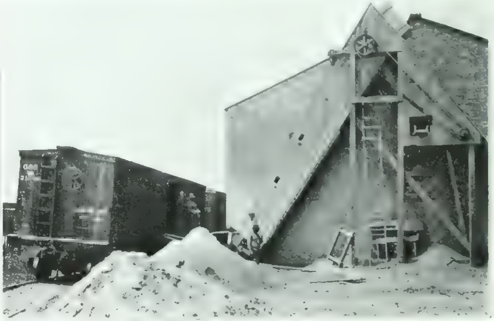


FIG. 16 SAND HANDLING EQUIPMENT FOR FOUNDRY

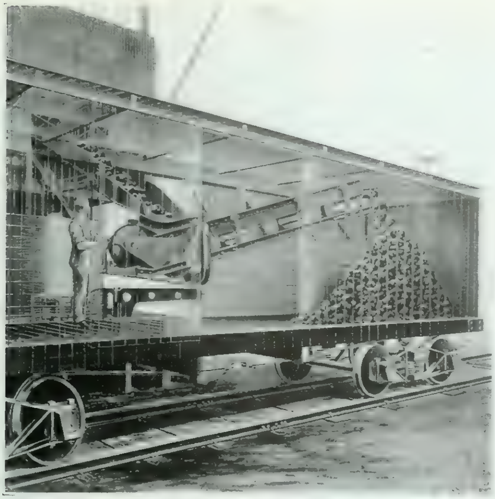


FIG. 17. BOX CAR LOADER

veyor under the boiler room floor is installed to take them to the elevator and adds to the efficiency.

Handling Coal from Reserve Piles

Conveyor equipments are used extensively to eliminate labor and expedite the handling of coal to and from outside reserve storage plants and there are various types of equipment and combinations employed. Clam-shell buckets are also used a great deal for reserve storage equipments and are operated by locomotive cranes, monorail electric hoists or sometimes by bridge tramways. Figure 13 shows a locomotive crane equipped with a clam-shell bucket which is used for handling coal to and from outside storage. Where the coal is being unloaded from barges the bucket can dig directly out of the barge, but where the coal comes in by rail it is usually first dumped into a pit or under a trestle, so that the bucket can get a better chance to dig into it. Sometimes a pile for the bucket to dig into is formed by handling it from the cars by means of a chain-and-bucket elevator or some other type of conveyor. In some cases the coal is handled directly from railroad cars by a clam-shell bucket but the cross braces and hoppered bottoms of the usual coal cars make this rather difficult. A standard gage locomotive crane equipped with a $1\frac{1}{2}$-yard clam-shell bucket can handle coal at the rate of 60 to 70 tons per hour with a good operator. If conditions are especially favorable this rate can be increased considerably.

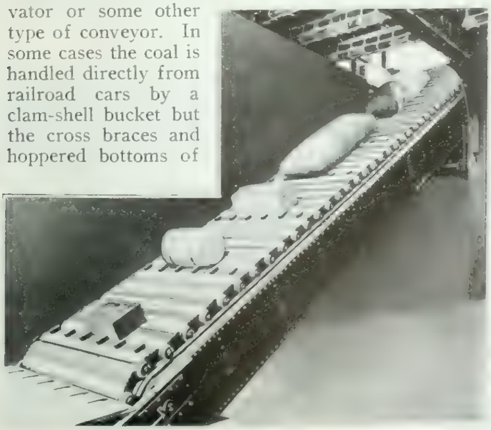


FIG. 18. CONVEYOR FOR [illegible]

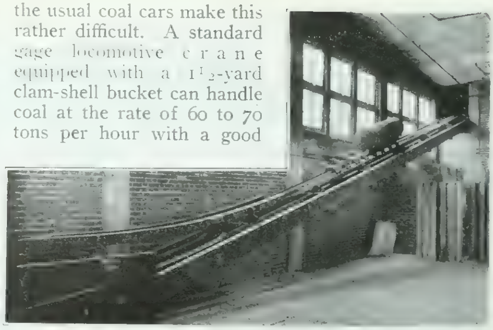


FIG. 19. CONVEYOR FOR ROLLS OF LINOLEUM

Handling Crushed Stone, Sand and Bulk Materials

Crushed stone, sand and other bulk materials are handled by methods that are more or less similar to the handling of coal, but they are not so free flowing and therefore not so easy to load and unload and hoppered bottom cars are not used so much for shipping them. The unloading points for crushed stone and sand are also apt to be for temporary use, as for instance, on some contracting job. Figure 14 shows an equipment for unloading sand or stone by digging out of the tops of cars. This device consists of a small chain-and-bucket elevator hung on one end of a hinged boom so that the boot of the elevator can be lowered into the material. A small storage hopper is provided so that the elevator can be operated more continuously and the wagons or trucks loaded more quickly when they come along. The framework for supporting the elevator and hopper is made so that it can be easily dismantled and moved to a different location. It has a capacity of about 30 tons per hour.

Two equipments for saving labor in unloading materials at foundries are shown in Figures 15 and 16. The

[illegible] HANDLING BAGS FOR CEMENT

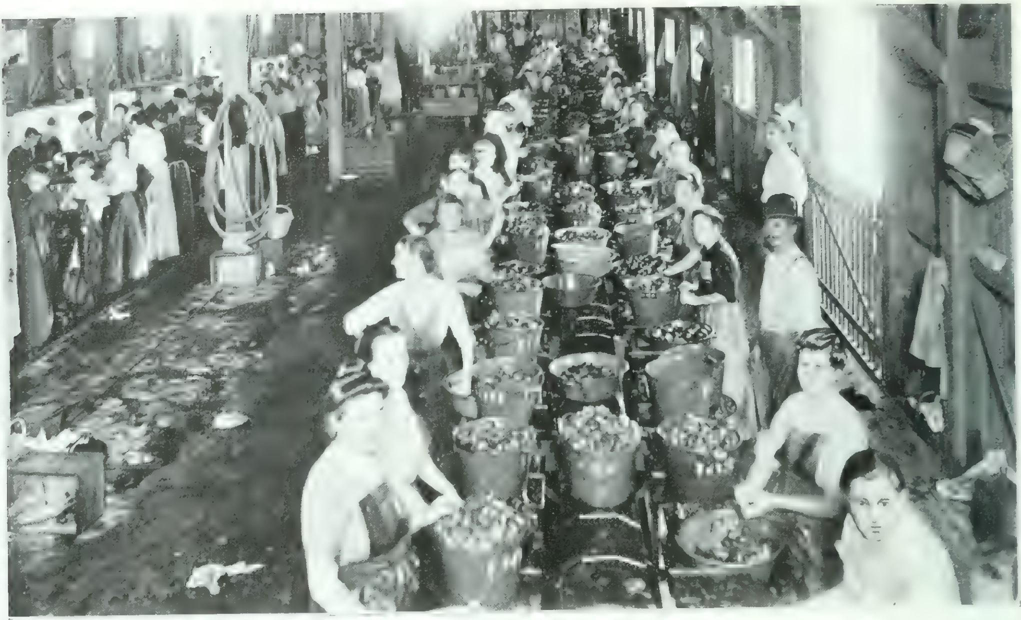


FIG. 21 TOMATO PEELING TABLE IN A LARGE CANNING FACTORY

former is a coke handling equipment for unloading from box cars and delivering to a bin at the same level as the charging floor. The coke is fed directly to the buckets of a chain-and-bucket elevator and transferred at the head of the elevator to a belt conveyor which distributes it along the length of the bin, where it is convenient for delivery to the cupolas. Little power is required to operate the machinery and the coke can be handled as fast as it can be unloaded from the car by two or three men, which gives a rate of about 20 tons per hour.

The latter installation is for handling foundry sand which is also received in box cars. Here also, the machinery consists of an elevator and distributing conveyor, the elevator being of a simple single-chain type, with a chain of special design to resist the abrasive action of the sand, and the conveyor, being reciprocating, is especially suitable for use as a distributor for sand. The bins in this case are ground bins with partitions to separate the several kinds used. Thirty tons can be handled per hour.

Figure 17 shows a machine for loading box cars, that is, for delivering the material into the cars without the labor of wheeling and shoveling it back. If the material is delivered at a uniform rate to these machines they will load it rapidly and with a minimum amount of labor. They are being used extensively for loading coal, coke, ore and various other materials. The manufacturer, the Manierre Engineering and Machinery Company, of Milwaukee, Wis., states that the 16-inch machine will load coal at the rate of four tons per minute, and the 24-inch machine six tons per minute. Two minutes are required to get the loader into and out of the car, including adjusting.

The handling of barrels, bags, boxes and other packages requires conveyors of types especially adapted to this sort of work and usually designed to carry the packages on arms or carriers, though they are sometimes pushed on skids or runways or allowed to travel over sets of rollers set at proper inclines. The moving platform type of carrier is used for handling miscellaneous freight to and from steamers in loading and unloading as shown in Figure 18. Sometimes the platform conveyors are used to take loaded trucks up or down an incline to relieve the stevedores of some of the harder part of their work and enable them to handle larger amounts. Chains with pushers extending up through slots in the floor are also used for this purpose.

Various types of machines are used for elevating and conveying certain packages and when these packages are of uniform size and shape the machines can be de-

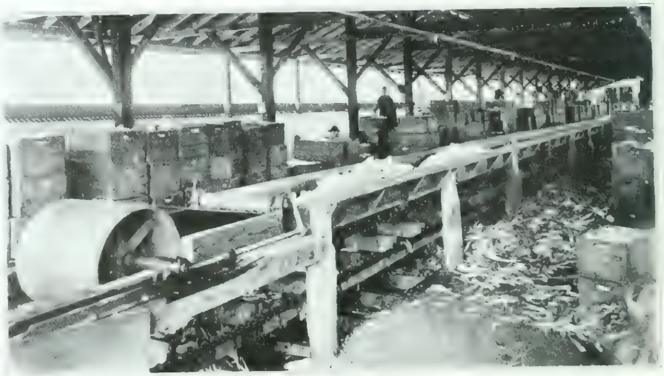


FIG. 22. CORN AND HUSK CONVEYORS IN HUSKING SHED

signed to suit the particular requirements. A case of this kind is shown in Figure 19, where heavy rolls of linoleum are brought down an incline from one of the upper floors of a linoleum plant and automatically discharged on a table in the shipping room. These rolls are carried in sets of saddles attached to a single chain and supported on rollers. At the discharge point the rolls are delivered to another set of carriers which tilt over sideways and let them travel over skids to a table. The capacity is a roll per minute.

For handling bags of cement or other material and for miscellaneous packages of moderate weight and size a belt conveyor makes an ideal machine. A machine of this kind will handle bags of cement as fast as they can be loaded. See Figure 20.

Two examples of conveyors in canning factory practice are shown in Figures 21 and 22. The former is a tomato peeling table where the peelers sit along tables arranged in the shape of a rectangle and with a conveyor travelling all along in front to bring the tomatoes in buckets, take them away after peeling and also remove the peelings. The conveyor travels between the stationary tables or benches at which the peelers work and is within easy reach of them. The conveyor runs at the slow speed of 40 feet per minute, but will handle the buckets and pans at a rate so that one machine will supply any number of peelers up to 200.

The equipment of Figure 22 is a belt conveyor handling corn in the husking shed of a canning factory. Here the husking is done by hand, each husker placing the corn in a box which serves as a measure to determine the amount husked. The corn is dumped from the boxes on the belt conveyor which delivers at the end of the shed to an inclined machine which takes it up and delivers it to a distributing belt conveyor from which it is discharged to the tables alongside the cutters. Underneath the belt conveyor in the shed there is a double-strand, wooden flight conveyor traveling in the opposite direction which takes the husks up an incline and delivers them to wagons or to a pile on the ground. The corn conveyors have a capacity of 250 tons per day, and the equipment makes it possible to operate with about 25 fewer attendants than would be required without it, a most evident economy.

American Women in War Industry—II

Problems of Living Conditions, State Laws, Coöperation of Labor Agencies and the Post Bellum Period

By C. E. Knoeppel

This first installment of the summary of answers to Mr. Knoeppel's *questionnaire on women [illegible] consists of the four items indicated in the headline above. All of the replies taken together present important points to be considered in laying the foundation for a national labor policy in regard to the employment of women.*

Mr. C. E. Knoeppel, *founder and president of the firm of C. E. Knoeppel and Company, consulting engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three firms of industrial engineers. This experience led to the founding of the organization of consulting and management experts that he now heads.*

G. LIVING AND SOCIAL CONDITIONS

The matter of clean, wholesome living conditions for women in industry can best be handled through an organization of the manufacturers of a community, unless a single plant is of such size that the necessary investment can be taken care of without embarrassment. The women in the vicinity of a plant will frequently have their own homes where they will live, but those drawn in from the surrounding country will require clean, wholesome places where they can board at a cost consistent with the wages that they receive. Many of these women can be placed by carefully canvassing the respectable families in the neighborhood and finding those who are willing to take boarders.

Good results can be accomplished by constructing boarding houses and placing them under competent managers. These can be run at cost, or at a slight profit, and excellent wholesome surroundings can be provided at extremely reasonable rates. Often women will desire to club together and take a house, and the company should be able to provide houses at reasonable rentals to those desiring them. The advantages of the company boarding houses are that they assure the women meeting other women and having social intercourse. The lonesome woman soon leaves her job and goes home where she is known.

IMPORTANCE OF AMUSEMENTS FOR WOMEN

The contentment of a woman employee might be said to depend one-third on wages and working conditions, one-third on living conditions, and one-third on good, wholesome amusement. The question of amusement is an important one and seldom receives the consideration that it deserves. If a woman thoroughly enjoys herself during her hours away from work, it will be difficult to induce her to leave the community she is in, even for higher wages.

Amusements are simple to provide, as they should be made self supporting, and all that is needed is the initiative to start them. Bowling, sewing, dancing and card clubs should be arranged for. All that is needed is bowling alleys where respectable women can go, or a room large enough for them to dance in, or where a number can sew or play cards. Even outdoor sports are appreciated and a few tennis courts could be used and paid for as used. Moving pictures are a standard amusement. If there is no theatre in your town where good pictures can be seen at a reasonable price, one should be provided.

If there are class distinctions, do not try to combat them, for you will fail. Let the women determine their own social levels and run their own clubs, admitting whom they wish. All you need to do is to supply the initiative to start them. Above all, do [illegible] on a charity basis. Let them pay for what they get, and make it as reasonable as possible. There never was a worker that did not resent anything resembling charity.

Y. W. C. A. cantonments, community kitchens and dormitories will assist materially in the matter of feeding and housing women workers, if the manufacturers of a locality cannot get together. On a large scale, social settlements can be developed.

Organizations should be found for the mental, social, physical and religious betterment and welfare of women.

Co-operative club houses to be run by women for women is another means for solving the problem of providing proper living and social conditions.

Do not overlook the importance of a woman's gymnasium in club houses, and arrange for women to invite their men friends to dances. Have fudge kitchenettes and spooning parlors—they will help materially.

Neighborhood recreation centers under church or women's societies can be worked out in a campaign to look after the women during their spare time. Provide plenty for them to do, but the decision must be theirs to a great extent as regards what they will want to do.

There should be instructions as to wholesome living conditions by traveling nurses and nurses' associations, or the Y. W. C. A. can do a great work in keeping living and social conditions on a high plane.

You must not overlook, however, that women workers are going to have a lot to say, and rightly so, about this big question of living and social conditions, and as many have said, the same pay as men for the same work will enable women to go a long way toward working out their own salvation. On the other hand, what is done for them, if it does not savor of charity, will be welcomed and appreciated.

Establish a Plan and Program

Employers can do much to see that right conditions are provided, but a far greater work can be done if there is plan and program to it all, backed by Government support and coöperation.

A Government commission should first of all work up proper conditions as to living and social welfare of women, leaving sufficient latitude for the consideration of purely local conditions, for they are bound to vary with the different sections. Certain matters pertaining to the health of women workers could be put up to the local health boards. Committees of women workers could be organized to work with the other bodies having this question of living and social conditions in charge.

Campaigns among industrial leaders, propaganda as to safety first, health, diet and the like, organizing the superintendents of plants to coöperate, are steps which will lead to substantial results.

An organization like the Y. W. C. A. or the State Councils of Defense could well have such a work in hand, or the women's clubs of the country could form committees and organize social workers' corps in the various localities.

Where legislation, either State or National, is needed to provide proper conditions for women, the women, in conjunction with the manufacturers and the Government officials, should themselves see to it that they get such legislation.

Work for the Social Secretary

A social secretary for each plant employing women would be an excellent move, these women to be selected by the Y. W. C. A., or directing body, to work on all problems affecting the lives of women out of the shops, the same as the plant matron looks after the conditions of women while at work in the plant.

Another suggestion is that living and social conditions affecting female labor should be investigated continuously by authorized parties appointed locally, these investigations to be paid for by the manufacturers employing women, in proportion to the number they regularly employ.

II. State Laws

As regards the matter of changing or unifying existing state laws, there was quite a difference of opinion. Some felt that national legislation was immediately necessary, while others thought that the laws in the various states were satisfactory as they are.

One suggestion was that national legislation should set aside present laws for the period of the war, after a standard set of rules governing woman and child labor had been developed, and finally enact a uniform Federal law governing all labor.

Another suggested that state laws should be modified and corrected wherever necessary, to circumvent both unfair employers and labor unions.

From the answers received, plus an analysis of the state laws, there seems to be a need for some national legislation of an emergency nature, so that standards can be set and then maintained. While it may be said, and truly perhaps, that the present is no time for new legislation as important as this, it was felt that much could be done by bettering the present laws.

Legislatures of the various states could appoint committees and work together and with the Government, women's organizations, labor unions and bodies representing the manufacturers, out of which a uniform law embodying the best in the present laws could be developed.

One suggestion was, "grant suffrage and then consult the women." Another was that a national organization be formed in which labor, the employers and the Government would be represented to undertake this matter of changes and unification.

A few words regarding the differences in the state laws will prove illuminating.

Of the 49 divisions represented, only California and the District of Columbia limit the day's work to 8 hours and the week's work to 48. Although an 8-hour day has been legislated by Arizona and Colorado, the week limit is 56 hours, thus countenancing the 7-day working week.

The 9-hour day for women is established in 14 states, in 6 of which the weekly limitation is 54 hours, in 3 it is 54 to 60 hours, and in 2 no weekly limit is fixed.

Ten hours women's work per day is lawful in 11 states, and 10¼ in New Hampshire (in a 55-hour weekly limit). According to the law as amended in 1911, Illinois permits a woman to work up to 70 hours in a week. (Later compilations are not available.)

Besides Illinois, 4 states allow a 7-day working week—Colorado, Montana, Texas and Washington.

Iowa and West Virginia place no limit whatever upon women's working hours, as such. Indiana appears to have no limitation laws; and as to 14 states, available information is lacking as to current status of such laws.

In a number of states certain occupational exceptions are made — especially as affecting women's night work; but speaking generally 37 states permit women to work after day shift, and 2 do not (Michigan and Pennsylvania). Nine states do not make the night-work clause effective unless it continues until 9 p. m. or 10 p. m.

In no particular is the lack of uniformity shown better than concerning an attempt to regulate minimum wages for women. Nine states attempt definite regulations but in almost all instances exceptions are in evidence.

Some states claim the minimum as "based on economic principles" (abbreviated BEP), but variance here is also great. California shows the highest minimum, $43.33 per month ($10 a week); but its BEP-rate is 13 to 16 cents per hour—and there is a "pound scale of wages" also. Utah gives 90 cents and $1.25 per day as a minimum, while Colorado makes the rate $1 a day, or $20 a month (which latter figure is equivalent to less than 80 cents a day for a 26-day month.

Though showing sharp gradations, the female child labor-age-limit is more uniform than any other of the data shown. There appears to be a genuine attempt to discourage employment of girls younger than 14 years. The 27 states naming this limit are outdone, however, by 3 states that place it at 15 years and by 10 states which have raised it to 16 years.

In seeking legislation to exclude women from objectionable occupations, it is natural that mines and saloons should be prominently mentioned; but the only other similarity affects "cleaning moving machinery"—an objective more appropriately reached, it would seem, by a general revision and clarifying of factory inspection and safety laws. Another similar illustration is seen in the attempt to bar women (New York) for "all grinding and polishing operations," whereas it is well known that adequate plant equipment will include exhausters that remove the dust-laden air and thus make such departments entirely habitable. Moreover, if it is well to make such exclusion of women on the score of public health, it is equally desirable to prevent the menace from reaching male workers, and the logical way to remove this and other industrial dangers is through carefully planned factory inspection and safety requirements, another matter that should be settled.

I. Coöperation of Labor Unions, Women's Associations and the Government

Labor Unions.—It was felt according to the answers received, that the labor unions would not take kindly to the introduction of women labor, and that we could expect to have the same trouble England experienced at first in her attempts to utilize women labor to the fullest extent. The clash that is ever with us between capital and labor, is another reason why this matter of using women in industry will not be settled without considerable discussion and debate between workers and employers. This will be especially true if the labor leaders take the stand later on that there is no shortage in labor.

In the first place, no wholesale attempt should be made now to use women in industry. Man power should first be employed fully and efficiently. Plans for women in industry should be worked out from now on, however, for in the event of a long war, which seems likely, women will be needed to the fullest extent. To this end steps should be taken by the Government, by manufacturers, and by women's organizations, to make organized labor realize the seriousness of the international situation. If public opinion cannot induce the leaders to see the need of women in industry, sheer necessity will sooner or later force them to allow women to work side by side with the men.

To secure the coöperation of labor, there should be publicity and appeal to show them the real situation as it is likely to exist in case there are several years more of war, in order to get labor to waive restrictions on output and the use of women during the war, as English labor did.

All steps should be fully explained at an early opportunity and nothing short of the utmost frankness on both sides should be considered for a moment.

Efforts should also be made to analyze and anticipate the fears of labor, for in this, as in everything else, differences are the result of misunderstandings, and *there should be no misunderstandings in this crisis.* It should be made plain to labor that no displacement of men will be made when men are available; that men returning after the war will be given work to do—and this must be a government promise that will be carried out. If these are agreed to, no difficulty should be encountered, especially if in the use of women there are the following considerations:

> *Equal pay for the same work; same hours; right of women to organize; suffrage; maintenance of proper working, living and social conditions.*

If labor objects after the above are provided, then it has no leg to stand upon, and the Government should step in, establish profits, arrange for compulsory arbitration, waive restrictions on output and use of women labor, prevent cutting of rates and insure proper working conditions.

My own conviction, and that of many I have talked with, indicates that organized labor will not object to women labor if it understands that women labor is not needed now and that the rights of women and of labor in general will receive consideration.

It is thought by some that labor unions should incorporate so that they can be dealt with the same as business corporations, then by bringing both together, with government representatives, proper rules and legislation can be worked out, that both would have to live up to.

It was also thought that women should be allowed to join unions or form new ones of their own, and that they should work in harmony with organized labor.

It was also felt that the War Labor Administration or the National Chamber of Commerce, or both, should in conjunction with the American Federation of Labor and the Council of National Defense, find a solution of the labor clash during war times.

Women's Organizations.—No difficulties are expected in securing the full coöperation of women's organizations, in fact they are doing nobly at the present time all they can to win the war.

In getting them to work to the fullest in making "women in industry" a real success, the appeal must be made to patriotism, sense of duty, the need for them in this crisis, and that the underlying considerations will be: equality with men, earnings as a basis for social standing, proper working, living and social conditions, right to organize, no loss of caste because women work in shops, no exploitation, same pay for same work, enforcement of better laws and the maintenance of high standards.

To this end propaganda is needed through the lecture platform, the press and magazines, churches and schools, and trips through plants to explain why women are needed, what they would be called upon to do, and how they would be called upon to do it.

Government. What was said with reference to union labor and women's organizations applies equally well to the government. Manufacturers must get together and work with the Government as well as with labor. The politicians must be made to see the need of women in industry in increasing numbers, and have the courage to come out and say so. The National Chamber of Commerce can be a factor along these lines. Some felt that full coöperation of the Government was unnecessary. Even if this is so, and I doubt it, it would be a decided help to get the Government to take the initiative and, working with the manufacturers and with labor, see to it that we efficiently use and at the same time properly safeguard our women workers.

The new War Labor Administration should make exhaustive investigations of this whole subject and, with Government officials in conjunction with representatives of manufacturers and labor, devise ways and means of using our women in industry.

J. POST-BELLUM CONSIDERATIONS

The question, What about women labor after the war? is a most important one. One of the reasons labor is opposed to women in industry, is its fear that women will remain to displace men after the war is over, a point which must be considered.

Many of those who answered the question felt that the situation would take care of itself when the war is over. Many soldiers will marry upon their return; women in the factories will meet and marry shop men and take up domestic work later on; other women who desired to do their share during the war will go back to the pre-war occupations or activities—homes, offices, life of leisure and the like—those who become skilful and like industrial work will want to remain in the shops. It was felt by many that if the war lasts long enough we will number our dead and disabled through injury or disease by the hundreds of thousands, thus depleting the industrial ranks.

The opinion of many is that the reconstruction is going to call for so much in the way of replacements, new construction and the like, that labor will be in great demand for years to come, and that this will induce many women to remain in industry.

The general feeling was, however, that the men who return should be given back their old jobs, or that new work should be found for them, that home would make the real appeal to women and many would drop out for this reason, and that while the life of independence and high wages would hold a great many at work, many others would drop out.

General other factors must be also taken into consideration. Many foreigners will return to their home countries after the conclusion of peace, which will make large gaps in our industrial ranks.

Steamship companies report that from 500,000 to 1,000,000 aliens are planning to go back to their respective countries when the war is over. About this point, Frederic C. Howe, Commissioner of the Port of New York, says:

> [illegible] labor there may be [illegible] labor [illegible] that make conditions most attractive are going to secure immigrants and keep their own population.

It must be remembered, also, that the war is teaching men the wonders of outdoor life, and many will go West and on farms, and this will also have its influence in creating a demand for labor after the war. While at first there is bound to be a violent readjustment, it will be of short duration, as there will be so much work to be done in the way of reconstruction that everyone who will want to work will find work to do.

One man said:

> After war, smart women will work, lazy loaf, same as now. Might put petticoats on third rate men and trousers on the smart women.

It looks very much as if the proposition will adjust itself, as men and women will fit themselves for tasks they can do best. We cannot get away from this basic argument, *if there is a dearth of men, women will be needed and will work, whereas if there is an over supply of men, women will have to give way.* The law of supply and demand may be expected to work here as in other things.

As a constructive measure a national commission should be appointed by the Government or the War Labor Administration to consider this very point, conduct investigations and work up a logical plan of demobilization of women in industry; of maintaining the army as it returns and releasing the men to industry gradually, so as not to dump millions of them on the labor market before plans for the handling of both male and female labor have been worked out.

In connection with these 12 questions, it may be interesting to note the replies by Hilda M. Richards, Chief, Women's Division, Department of Labor.

Questions	*Answers*
1. How are we going to find the army of women needed?	Through registration at city, state and Federal employment offices and all other agencies.
2. What basis will we use for selecting women?	Experience and training.
3. What efforts will we make to provide proper living conditions?	Must be provided through government housing.
4. What changes will we have to make to provide working conditions?	Establish through legislation.
5. What social conditions will we have to provide?	Provision for recreation and volunteer units to look after women like the English system.
6. What hours should women work and how about rest periods, fatigue and the like?	Eight hours.
7. How will we arrange to subdivide and arrange the operations so that women can efficiently perform them?	?
8. How will we train women and who will do it?	Through vocational training schools and classes in factories under government.
9. What steps will be necessary to induce the full co-operation of	
(a) Labor unions?	Committees.
(b) Organizations of women?	Dr. Anna Howard Shaw Committee.
(c) Our Government?	Department of Labor, Women's Division.
10. What step necessary to change and unify state laws?	None.
11. How will we adjust and arrange the wages of women?	By careful legislation like the 8-hour law for engineers, conductors and trainmen.
12. What will we do with reference to woman labor after the war?	Prepare now. Commission ought to study readjustment.

Electric Heating in Manufacturing

By Thomas Robson Hay

Electric heating is becoming more and more widely adopted in industrial processes because of several marked advantages, and in spite of the disadvantage of cost. The author covers both of these features and then takes up a number of practical points in installing and operating electric-heating equipment.

Mr Thomas R. Hay has been engaged for the past *eight years in the testing, application and sale of electric apparatus. This includes four years with the General Electric Company in their testing, switchboard and mining departments and in industrial sales work at the Cincinnati office. For the past three years he has been a power salesman for the Duquesne Light Company with headquarters in Pittsburgh, Pennsylvania.*

ONE of the most significant industrial growths of recent years has been the progress in the development and use of electricity for producing high-grade steels, and for special operations, such as heat treating, annealing, japanning, baking and enameling. This growth has been due primarily to the development of the means of generating heat by electricity and to the ability to control and apply this heat properly and satisfactorily. In the early days of the electric heating industry in this country, applications were practically confined to the production of high-grade steel castings. But as more experience was gained and further experiments were conducted by interested manufacturers, new fields opened for development, until now, in many localities, electric heat is largely used for important manufacturing purposes.

At first the application of electric heat in its different forms was made cautiously on account of the meagre technical and metallurgical data available, and also on account of the comparative inexpensiveness of gas and coal as fuels. In recent years, however, in fact during a period signalized by the practical development and use of electric heating appliances, improvement has reduced the overall differential between the costs of electric heat and heat produced direct from fuels to such an extent that electric heating engineers have been encouraged to continue development work on thermo-electric equipment, and manufacturers have been encouraged to assist in this development, on account of the fact that costs can be realized that are somewhat comparable with costs obtainable when using cheaper forms of heat.

Like the electric motor, the application of electric heat, in a great measure, owes its successful commercial and economic use to the comparatively recent and rapid growth of modern distributing systems. With but few exceptions the power for producing electric heat is purchased from the central stations whose power supply is universally polyphase at 25 or 60 cycles, with delivery at any voltage desired by the consumer.

ADVANTAGES OF ELECTRIC HEATING

The principal advantages of electric heating over other methods are:

1. Saving in time, labor and space, with attendant saving in overhead, real estate and taxes.

2. It can be used in any atmosphere, resulting in vastly improved conditions of labor.

3. It is clean, sanitary and safe, resulting in reduction of the fire hazard, risk of loss of material, product, and even life itself.

4. It gives a greater thermal efficiency.

5. It offers a ready and easy means of exact automatic temperature control to an extent impossible with other methods of producing heat.

6. Any quantity of heat can be obtained, as wanted, for exact application in a definite and fixed amount at the point needed and as desired.

7. The heat can be concentrated at any desired point and confined to definite, fixed areas.

8. It is more flexible and economical in usage and can be readily and easily applied to a large variety of uses.

By its use greater product for a given time is obtained, and the quality of product improved, resulting generally in lower unit costs.

ELECTRIC HEATING IS A DESIRABLE LOAD

Electric heating presents a very desirable load for the central station, because it operates at a high load factor, takes, for the larger installations, a comparatively large number of kilowatt-hours at one point with relatively long hours of usage, and is practically a non-inductive load resulting in a high power factor. After the connection is once made, very little attention is required on the part of the central station and, where necessary, the load can be adjusted so as to be largely off-peak.

When the use of electric heating equipment is being considered, there are three important features of such usage which should be given most careful attention. They are: 1, Ample finances; 2, proper conception of the functions and possible uses of electric heat; 3, correct decision as to the proper size and type of heating equipment to be used.

1. Many contemplating the use of electric heating equipment go into the matter without having a clear and definite conception of the needed capital to make the operation a success. The result is that the initially available funds are apt to be exhausted or greatly reduced before much more than a start has been made. The use of electric heating equipment involves the purchase not only of the necessary electric heaters, but also among other items, it necessitates the purchase of expensive auxiliary electrical equipment, such as automatic temperature regulating devices, copper busses and cables, oil circuit breakers, necessary recording meters, switchboard equipment, etc. In addition to the electrical equipment it is necessary to practically rebuild and to thoroughly insulate existing ovens, where electrical heating is to be applied to "going" plants. This necessary adaptation is usually costly and is apt seriously to interfere with oven production and plant output. Usually it is more economical to use new equipment rather than to try to adapt existing oven equipment to electric heat. When electric heating equipment is added as an incident to manufacturing production, new buildings may be required or old buildings must be adapted to the new operation. The cost of the ovens or furnaces, with the necessary accessory equipment, is, it must be borne in mind, in addition to building and real estate costs.

2. A proper conception of what can be done with electric heat and proper selection of the complete heating equipment, both as to size and type, is a fundamental requirement. Manifestly, it is a mistake to try to use electric heat in all industrial heating operations, as, by the very nature of the intermittent methods and inefficient use of heat of many processes in their existing form, the energy charge, which in many cases is a major operating charge, would be prohibitive. There are, however, some special cases where it is advisable to use electric heat, even though its cost may seem excessive, but such cases are of infrequent occurrence.

The increase in the use of electrical heating devices has been due partly to the demand for a higher grade of product, at an equal or less cost, partly to the enthusiastic and energetic efforts of those engaged in the development and sale of these devices, partly to a desire or necessity on the part of those whose business is increasing, to try out electric heating equipment or to reduce costs by modernizing their plant, and partly to a desire of every manufacturer to be as well, or better, equipped than his competitor.

3. The size and type of equipment installed will be determined largely by the volume of output, size and character of product to be heated, character of heating process and location and dimensions of space available. When choosing equipment it is necessary to consider the particular operation as a unit, so that each part of the apparatus and each step of the process, as well as the heat applications, will all work together in the proper cycle and sequence and in the most economic and efficient manner possible. Some particular features that should be considered relate to the conveying system, to the kind and thickness of insulation that must be provided, to the amount, size and character of metal continuously in the heater, continuous or intermittent operation, ventilation, charging and drawing facilities, etc. In making an application, such a size and type must be used as will insure maximum efficiency and accessibility, and the furnace must be so designed as to enable an even and constant distribution of heat to maintain a uniform temperature.

Advice and Attendance

After the decision to go ahead has been made and the needed equipment decided on, the next matters to be correctly determined and carried out relate to the following: 1, selection of consulting engineer; 2, proper electrical and mechanical installation; 3, competent attendance.

1. The selection of a consulting engineer, if one is called in, is most important. One should be chosen who is technically and professionally qualified by training and experience to advise correctly on the matter in hand. He should preferably have had actual electric heating experience, and should have a good working knowledge of the different phases of the matter under consideration, as well as of the electrical features of electric heating operations. In some cases the consulting engineer has attempted to advise regarding such installations, when he was as ignorant of the matter in hand as his client.

2. The commercial and operating success or failure of any electric heating installation, providing the requirements mentioned have been properly fulfilled, will be due, in a great measure, to proper electrical and mechanical installation.

The installation of the heating equipment and its auxiliary equipment, including temperature, voltage and current regulation, control switches, bus bar structure and connections, and temperature and electric metering equipment should be a unit, and should be compact and flexible in assembly and installation. All electrical equipment should be readily accessible to the operator, and installed in such a manner as to reduce the length of secondary copper leads to a minimum. Reduced lengths of secondary leads will act to reduce the amount of external reactance in the electric circuit, thus maintaining the power factor of this circuit at a maximum and enabling the maximum introduction of heat to the heating equipment, a condition necessary for success.

Design and Installation

Aside from the electrical installation, particular attention must be paid to the design and installation of the heater itself. Frequently a manufacturer who has used several kinds of appliances comes to realize the many benefits to be derived from electric heating. His first impulse is to make the necessary installation as cheaply as possible, and his natural move is to place the needed electric heating units in existing apparatus. In a few cases this can be done satisfactorily, but in the great majority of instances the old equipment cannot be economically and efficiently adapted without practically rebuilding the existing apparatus: Generally the thermal efficiency of such installations is very low and the method of operation is not of such a character as to be readily adapted to the use of electric heating. The losses from low thermal efficiency and awkward operation, when capitalized, will usually more than warrant the installation of modern, up-to-date equipment throughout.

There must be ample and sufficient space for the accommodation of materials to be charged and proper facilities for the charging operation. There must also be proper accommodation for drawing and storage, and for the prompt handling of transfer trucks. All parts of the heating equipment, heating devices and auxiliary electrical equipment must be readily accessible for prompt repair or removal.

3. Competent attendance is an essential in all successful electric heating operations, especially for heat treating, annealing and forging. Two equipments installed properly and in accordance with the most up-to-date practice may differ widely in the results obtained, due to a difference in degree of expertness of attendance. While it is generally true that electric heating does not require the same degree of highly skilled attendance needed for the successful operation of furnaces producing electric steel, it is also true that this factor of competent attendance should not be neglected if a successful operation is to be depended upon.

Benefits Often Offset Increased Heating Costs

Many have been surprised to learn that it is possible for electrically generated heat to compete successfully with heat obtained by direct combustion of fuel, and particularly with heat derived from gas combustion, a method which had come to be recognized as almost standard practice. Yet this fact is susceptible of ready demonstration in cases where conditions permit of such substitution and application.

As a matter of fact the crux of the whole matter lies in the fact that the cost of energy used for most heating operations is generally a relatively small percentage of the *total* final production costs. The benefits that attend the proper application of electric heat will usually be found to more than offset any comparative increase in fuel costs. As a matter of fact, the cheapest method of heating is that which reduces the unit costs of a satisfactory product to a minimum. If improved quality has a money value convertible into cash, it may even make a process showing higher total costs the cheapest in the end. Production in many cases may be increased without increasing plant equipment. Generally speaking it is not that form of heating which is cheapest that should be used, but rather that form with which the greatest ultimate economy, consistent with efficient and continuous production, is obtained.

Experience proves that electric heating gives perfect heat distribution and permits of greater flexibility in temperature control than can be obtained when using other fuels. By the use of automatic regulating equipment the quantity of heat can be controlled and the temperature can be maintained constant at the point which gives the best results.

So recent has been the demand for electric heat in varying quantities that little authoritative and detailed information regarding its utilization is as yet available, outside of a few trade papers.

The electric heater in several different types is now generally standardized as to fundamental design and application and has come to stay. Central stations are recognizing this fact, as is evidenced by the willingness to reduce rates to such a point as to make it economically profitable to the manufacturer to substitute such equipment for other equipment that may be in use. This reduction in rates to a mutually profitable basis, together with the continued improvements and refinements in the design and operation of the electric heating apparatus, will continue to promote the use of such equipment with corresponding advantages in manufacturing.

Managing Non-Repetitive Work

How Conditions and Operations Can Be Standardized for Tool-Making and Machine-Shop Repairs

By Norman Howard

Mr. Norman Howard *after preparing for college entered an apprenticeship in the machine shops of the National Conduit and Cable Company. After finishing his time he stayed with that firm, advancing to the position of foreman. During the past five years he has held positions from foreman to factory superintendent in several machinery building plants, including the Remington Arms Company and the Spicer Manufacturing Company. He is at present engaged in improving shop organization and methods in the plant of the Hyatt Roller Bearing Company, Harrison, New Jersey.*

Machine-shop jobs that occur but once or seldom, or have but a single piece or a few pieces, present a real problem as regards estimating their cost in advance. This article shows how to standardize the conditions and operations for such work as a preliminary to paying bonus and thus control cost. As much of this work is tool-making, tool repairs and equipment repairs, the most highly skilled men in the shop are involved and a difficult problem thereby presented.

THE work of the firms where the principles of industrial management have been successfully applied has been almost entirely repetitive or mass production. But few attempts have been made to apply these same principles to non-repetitive work, such as the making of repairs or doing jobbing work such as is commonly found in most machine shops. Practically every large manufacturing plant has a considerable number of men engaged on the repair of dies, jigs, fixtures, small tools and machinery, or on the general up-keep of equipment. This article takes up the preparatory work that was done in such a department where modern methods of management had been put in force. The writer hopes that the managers of machine shops doing jobbing work will be interested and possibly helped by what will be presented.

To-day, in a well organized plant making a standard article, we expect to find that the various productive operations have been standardized and time studied and that the operators have been put upon either bonus, premium or piece work. The management problems to be solved in such a plant are well understood and the methods of solution are familiar to most of us. But the machine-shop on non-repetitive work presents a more complex problem, and one upon which little constructive work has been done. So generally true is this statement that the tool room and machine-shop on non-repetitive work are often looked upon by the management as a sort of necessary evil; as a place where a number of more or less efficient men demanding considerably higher wages than the rest of the employees, are maintained at a large item of expense and without any accurate understanding on the part of the management. Whether these highly paid mechanics are really benefiting the firm in true proportion to the pay they are receiving, is often a question. The men themselves are without the stimulus of a "reward for efficiency" and are guided by the judgment of their foremen and the availability of other places of employment as to how much they turn out as a day's work.

It would be highly beneficial to all concerned to know in advance what time each mechanic should take to complete a given job, and, with this time known in advance, to put each man on bonus and so give higher wages to those who are really efficient and, similarly, to limit the pay of those who are not. The writer purposes to explain a method that has been followed to accomplish this purpose, believing that it will prove equally effective in any other shop if conscientiously undertaken.

A Too Common Incongruity

Before proceeding to explain this method, however, I would like to point out an abuse that is prevalent in many large shops, and one which this system will correct. It is incongruous to find an unskilled machine-hand, knowing and performing a single operation on productive or repetitive work or on piece work, earning as much and often more than a fully skilled mechanic, who is working in the same shop under the ordinary day-rate plan of wage payment. This condition does exist in many shops and it is a constant source of irritation to the more experienced mechanic.

We can also appreciate the point of view of the management that is willing to pay high wages to the men that "produce the goods we sell" if that man increases his personal output. We can likewise appreciate the reluctance of the same management to go on increasing independently the wages of mechanics and tool makers, working at a day rate, and seemingly taking a very long time to get out the work assigned to them to accomplish.

Estimating Costs in Advance

It is evident that before we can employ any of the newer systems on wage payment we must know how long it takes to perform an operation or to produce a piece, or must have an accurate estimate of the cost of the piece before the work is started. So from one viewpoint our management problem narrows down to methods that can be followed in estimating the advance cost of any job that occurs, no matter how many pieces there be nor how seldom the job is done. From these predetermined estimates the pay of the mechanics can be proportioned, the efficient and inefficient discovered and the work speeded up in a just degree without increasing the burden of any worker. As a matter of fact the coöperation of every mechanic will be gained once he understands that the new methods will help him to earn larger wages. The same remarkable increase in production usually obtained when bonus work supersedes day work on production operations can likewise be obtained on non-productive operations. It is a safe prophecy to say that wasteful, old-fashioned methods of working are bound to disappear from the machine shop doing non-repetitive work in the same way that they have very largely disappeared in the modern manufacturing plant.

The Point of View of Costs

Looking at the matter from the point of view of costs, if a manufacturer could know in advance what it would cost him to make a certain die, or a particular fixture, or build a special machine, in many cases he could contract for this work outside and save money. Because of mechanical equipment or employees with peculiar skill, an outside shop can frequently handle a certain job more economically than the one where it originates. Overhead charges and material on hand are two other items that play an important part in determining differences in cost.

The spur that comes from modern industrial management methods acts both ways. The bonus reward brings increased production from the worker, for it offers an incentive to him to use his abilities to the best advantage. He realizes that every corner he can cut, either by thought or action, directly increases the sum of money in his pay envelope. On the other hand the management must assume its proper responsibilities, and, as a rule, the executives are more to blame than the workmen for the wasteful conditions and methods that so often exist.

Standardized Conditions

The first step in preparing to put a tool-room on piece work or bonus is to go over the machine equipment and put it into proper shape. This means that the machine-tools must be so repaired or modified that they will carry the feeds and speeds that will be later required of them. Many belts must be cleaned, tightened, repaired if necessary, and this matter must not be left to an oiler who merely walks around the shop taking out an inch here and another inch there where a belt has become so loose that it will not pull. Later this belt work must be put under the direction of some one who understands the fundamentals of the important subject of belting.

In the inspection of the machines, missing and broken wrenches must be carefully replaced and provision made so that each man will *continually* have each wrench where it belongs when he starts to work every day. A few missing wrenches or gages can cause a great deal of wasted time, especially where one shift of workmen follows another.

The same kind of study must be made of all hand tools, such as drills, taps, chucks and the like. All of these the management must supply in an adequate number and keep carefully checked up. The care of these articles must not be left to some one who lacks the authority to demand a proper accounting. Standards for lathe tools or tool belts must be determined, sketched up and blue-printed with a standard shape and angle for every purpose. There is a most efficient shape of tool for roughing hard steel, another for soft steel, and so on, each tool has a most efficient clearance angle, side slope, top slope, and so on, according to the purpose for which it is to be used.

In our shop we use a set of 24 bits arranged in a block of wood having 24 holes. Each man may have a set, knowing that he is personally responsible for each bit as well as the whole set. He must assume responsibility for every loss in the same way that he does for his personal tools. When a bit is worn down or broken, or needs grinding, a new one properly ground will be exchanged for it at the tool crib. A mechanic's time is too valuable to have him grind tools. Besides, it is difficult for him to grind them to the proper angles. A boy, or even a girl, in the tool crib with proper fixtures and gages can grind tools and drills for a number of men, and keep them supplied at a far smaller cost than if the men did their own grinding.

Lathe hands are expected to sharpen their own lathe tools at the nearest wheel, but not in any case to change the angles. This grinding should be done on the clearance only.

Standardized Belt Speeds

Another thing that must be standardized is the belt speeds. Divide the lathes as nearly as possible into groups, according to their pulling power. I do not advocate the scrapping of any machine tools that can be made to turn out work, although it may be necessary to turn them over to the apprentices and keep the better machine tools for the older mechanics, who should have the first opportunity to earn bonus.

Practically we have not considered it wise to set exact limits for each machine tool as regards the best feed, speed and cut for each job. But rather we have arrived at a standard depth of cut at a standard feed and speed for roughing purposes for each group of machines according to power and size. For a shop turning out comparatively light work it is perhaps practicable to fix upon a ⅛-inch cut on a side with a feed and speed as nearly as possible to those set by Dr. Taylor for turning speeds for high-speed steel. If a machine is not equipped to use a lubricant or coolant it is possible to get equal or greater results by using stellite.

Where necessary, speeds can be equalized by changing pulleys.

The next step in this preparatory work is to improve the service to the mechanics by supplying them with everything needful. Arrange for supply boys to get tools and wrenches for the workman, bring his material, obtain his blue-prints and instruction cards. Any man who is striving to earn bonus will resent being taken away from his machine, even if it is to get some of these things that he must use. He is increasing his earnings only when the machine is at work.

It is also necessary to introduce an instructor especially to help the younger men and apprentices. If a reliable system of despatching the work is installed, it is possible that the assistant foreman can be detailed to do the instructing. If he is a popular man, it is far better to do this than to bring in an outsider "to show them how."

STANDARDIZING OPERATIONS

After conditions have been standardized it is necessary to take up the shop operations. Our first classification must distinguish between machine-work and hand-work, and for convenience I have adopted the following three divisions:

M. Mechanical operations (that is, where the machine is working alone).

C. Combination operations (that is, where both man and machine are working).

H. Human operations (that is, where the man alone is working).

These three letters, M, C, H, then form a part of the symbolization in the complete list of machine-shop operations which is given herewith. It will be noticed that the machines covered are the lathe, drill press, miller, planer and shaper. To show the method used in classifying machine tools we will assume an equipment of 20 lathes and divide them into three groups. Because of the variation in design, capacity and use, the lathe is the most difficult machine tool to consider.

In this equipment of 20 lathes, let us say that the largest group contains five machines: L-1, L-2, L-3, L-4 and L-5. They constitute Group 1. Let us assume, also, that the next group contains 10 lathes, numbering from L-6 to L-16 inclusive, comprising Group 2. The remaining five lathes are small in size and are L-16 to L-20 inclusive, and form Group 3.

All of the lathes of Group 1 are capable of taking a 3-16-inch cut at 1-32-inch feed at the Taylor speed of 113 feet per minute on medium hard steel, using a ½-inch tool. Group 2, comprising the medium-sized lathes, will take roughing cuts ⅛-inch deep on a side at 1-32-inch feed at the Taylor speed of 128 feet per minute. The small lathes in Group 3 will take a ⅛-inch cut on a side with 1-64-inch feed at the Taylor speed of 202 feet per minute.

Whether the Taylor cutting speeds are adopted or not depends somewhat upon shop conditions, but in any event standardized speeds should be determined for the metals commonly worked and for the lathes according to groups.

Turning again to the tables of machine-shop operations, the manner in which the primary and specific operations are combined is plainly seen. For instance, the operation of turning an outside diameter with machine feed is designated as ML-1; turning an outside diameter with hand feed is CL-1, and rough chucking becomes HL-1.

This sub-division of operations as presented in the tables has been most carefully worked out and is perhaps one of the most valuable features of this article.

In a following paper the author will present the methods used in setting times and applying bonus.

MECHANICAL OPERATIONS

LATHE WORK USING POWER FEED

M.L.1. Turning outside diameter
2. End facing, over two inches in diameter
3. Drilling
4. Boring with boring bar
5. Boring with off-set tool
6. Boring taper
7. Cutting external thread
8. Cutting internal thread
9. Reaming
10. Taper reaming
11. Knurling
12. Cutting off, over two inches in diameter
13. Cutting countersink
14. Cutting square thread

DRILL PRESS WORK USING POWER FEED

M.D.1. Drilling
2. Reaming
3. Countersinking
4. Counterbore

MILLING MACHINE WORK USING POWER FEED

M.M.1. Milling
2. Boring
3. Reaming
4. Cutting keyway

PLANER WORK USING POWER FEED

M.P.1. Planing

SHAPER WORK USING POWER FEED

M.S.1. Shaping
2. Cutting keyway

COMBINATION OPERATIONS

LATHE WORK USING HAND FEED

C.L.1. Turning outside diameter
2. End facing, under two inches in diameter
3. Centering on lathe
4. Centering on special lathe
5. Cutting off, under two inches in diamter
6. Drilling
7. Boring with boring bar
8. Boring with off-set tool
9. Boring taper
10. Reaming
11. Reaming taper
12. Cutting external thread
13. Cutting internal thread
14. Cutting square thread
15. Cutting countersink
16. Cutting counterbore
17. Cutting radius, concave
18. Cutting radius, convex
[illegible]
20. Squaring corner
21. Knurling
22. Filing, by hand
23. Emerying, by hand
24. Polishing, by hand
25. Burnishing, by hand
26. Spring winding, by hand
[illegible]

[illegible]

C.D.1. Drilling
2. Reaming
[illegible]
[illegible]

[illegible]

C.M.1. Milling
[illegible]

[illegible]

C.P.1. Planing

[illegible]

Human Operations Without Assistance from Machine

AT LATHE

H.L.1. Rough chucking
2. Finished chucking
3. Eccentric chucking
4. Reversing jaws on chuck
5. Adjusting chuck setup
6. Change from chuck to face plate
7. Change from face plate to chuck
8. Centre setup
9. Placing dog on work and taking off
10. Placing special jig in chuck
11. Placing work in special jig
12. Taking work out of special jig
13. Bolt and strap setup on face plate
14. Remove setup on face plate
15. Remove work or jig from chuck
16. Set lathe tool
17. Remove lathe tool
18. Adjust lathe tool
19. Set lathe holder
20. Remove lathe holder
21. Set taper attachment
22. Change taper attachment
23. Set over tailstock
24. Set over headstock
25. Set cross compound on angle
26. Set centre rest
27. Adjust centre rest
28. Set follower rest
29. Gage outside or inside diameter
30. Mark or measure length of cut
31. Grind lathe tools
32. Alter belt position
33. Alter gear position
34. Clean machine
35. Manipulate machine

AT DRILL PRESS

H.D.1. Place drill in socket
2. Drive drill out of socket
3. Lower table
4. Raise table
5. Strap and bolt setup on plate
6. Remove strap and bolt setup on plate
7. Vise or jig setup on plate
8. Remove vise or jig setup on plate
9. Place work in vise or jig
10. Remove work from vise or jig
11. Lower spindle to work
12. Raise spindle from work
13. Grind drill
14. Gage depth of hole
15. Alter belt
16. Clean table
17. Clean special jig
18. Lay out work
19. Manipulation of machine

AT PLANER

H.P.1. Place tool in holder
2. Adjust tool head on angle
3. Run tool head or carriage off centre of bed
4. Raise tool head
5. Lower tool head
6. Strap and bolt setup on bed
7. Remove strap and bolt setup on bed
8. Vise or jig setup on bed
9. Remove vise or jig setup on bed
10. Place work in vise or jig setup
11. Remove work from vise or jig setup
12. Gage work
13. Grind tool
14. Alter belt position
15. Clean table
16. Clean special jig
17. Lay out work

AT SHAPER

H.S.1. Place tool in holder
2. Adjust tool head
3. Run carriage across table
4. Adjust table higher
5. Adjust table lower
6. Strap and bolt setup
7. Remove strap and bolt setup
8. Vise or jig setup on table
9. Remove vise or jig setup on table
10. Place work in vise or jig setup
11. Remove work from vise or jig setup
12. Gage work
13. Grind tool
14. Alter belt position
15. Clear table
16. Clean special jig
17. Lay out work

AT MILLING MACHINE

H.M.1. Place cutter on arbor
2. Strap and bolt setup
3. Remove strap and bolt setup
4. Vise or jig setup
5. Remove vise or jig setup
6. Set work in vise or jig
7. Remove work from vise or jig
8. Angle plate setup
9. Remove angle plate setup
10. Index head setup
11. Remove head setup
12. Move work to cutter
13. Raise table
14. Lower table
15. Move table right
16. Move table left
17. Gage work
18. Clean table
19. Clean special jig
20. Alter belt position
21. Adjust cutter
22. Lay out work

BENCH WORK—ASSEMBLING, MARKING AND FORMING

H.B.A.1. Handling or placing work on bench
2. Lay out work
3. Clamping in vise
4. Removing from vise
5. Placing in screws
6. Taking out screws
7. Placing in bolts
8. Taking out bolts
9. Putting on nuts and tightening
10. Taking off nuts
11. Driving a fit together
12. Driving a fit apart
13. Riveting by hand
14. Peening by hand
15. Straightening shaft on straightening vise
16. Straightening sheet metal on flat surface
17. Bending sheet metal in vise
18. Spring winding on bench by hand

BENCH WORK—CUTTING OR REMOVING METAL

H.B.C.1. Drilling with portable electric drill
2. Drilling with ratchet drill
3. Drilling with breast drill
4. Reaming by hand
5. Tapping by hand with tap and holder
6. Thread cutting by hand with die and holder
7. Chipping with hammer and chisel
8. Chipping oil grooves with hammer and chisel
9. Counterboring with hammer and chisel
10. Plat filing by hand
11. Radius filing by hand
12. Burring with hand file
13. Grinding with portable electric machine
14. Emerying by hand
15. Tapping with portable electric machine
16. Tapping by hand
17. Fitting and filing
18. Scraping by hand, steel surface
19. Scraping by hand, soft boxes or bearings

A number of high-grade technical men are wanted for positions in industrial establishments by the U. S. Army Ordnance, through the Civil Service.

Chemists and chemical engineers, expert gas manufacturers, mechanical engineers, power house men, and machine shop foremen are required immediately.

Salaries ranging from $1,600 to $6,000 a year will be paid the men who qualify for the places.

An important service can be rendered the Government at this time in securing men with proper qualifications to carry on this most essential and important work.

What I Would Do If I Were a Foreman

By Mark M. Jones

The author is daily in contact with many foremen and so points out from first-hand experience the places where foremanship might be improved and made more effective. So he has written down the things he would do if he were a shop foreman, and the attitude that he would foster toward his workmen on the one hand and toward the other executives of the plant on the other.

Mr. Mark M. Jones' early experience was in the *traffic department of a street railway in Waterloo, Iowa. Later he was traffic manager of the William Galloway Company. Then in California, he held several positions connected with traffic, finally becoming industrial secretary of the Oakland Chamber of Commerce. In 1916 he came East to undertake his present work as Supervisor of Personnel of the Thomas A. Edison Interests at Orange, N. J.*

IF I were a foreman, I would first analyze my own job and endeavor to determine my true status in the organization. This, not so much from the political standpoint as from the organization standpoint. If the practical working out of the general scheme did not clearly show me where I stood, I would reach further into the theory of the organization with the view of tracing out the particular lines of responsibility running to my position.

Having determined upon this step, I would probably discover that whether the business is large or small, the executive head of it is theoretically doing everything in the business. He is keeping the books, selling the goods, firing the boilers, shipping the product and doing everything else, whether there are ten thousand people in the organization or ten. Having definitely decided that the executive head is actually doing it, so far as final responsibility is concerned, I would then conclude that inasmuch as we have passed from the individual stage in industry, he has been unable actually to do everything referred to above, and has delegated certain responsibilities to other persons. By so doing he has made that person an agent, and I, being his foreman and his agent, should do the things he would do if he were in my position. I would therefore feel that every thought and act, so far as the responsibility resting upon me is concerned, should be as nearly as possible that of the head of the business. If Mr. Edison were the head of my particular enterprise, I would endeavor to so act that in every instance I would do the same thing Mr. Edison would do if he were in my position. I might not always do it, but I would make a great effort toward it.

A Man Cannot Fight With Himself

Having arrived at that conclusion I would soon observe that other foremen around me were lacking in appreciation of these fundamentals, indulging in unnecessary arguments and losing time over minor questions, such as in what column a certain charge should be placed, or whether a truck belongs to this department or that, or whether this man ought to be transferred, etc. I would see that such arguments have no status in the general scheme of things where one man does everything. It rather seems ridiculous to me to think back and, considering that one man is doing everything, justify quarrels between two parts of the same man. How can a man fight with himself?

When two men under the same executive head do not work together you have an example of a man fighting himself. When the foreman producing the goods ahead of me, or the man to whom the products of my department are passed, comes in with something worthy of consideration I can take it up from the standpoint of Mr. Edison and soon realize that it is far beyond a personal matter. I am simply doing what Mr. Edison would do in the same situation; the foreman of the department ahead of me is doing the same thing; the foreman of the department to which my products go is also doing the same thing. After discussion, we should be able to arrive at an understanding without the necessity of bothering the superintendent. This, of course, will come about providing we all understand our true status. Following this line of argument still further, I can see that, after all, there is no place in industry for a man who cannot coöperate with others. I soon see that the day of the individual is over, and that a man must study human relations if he expects to exist in the world at all. The only way he can avoid human interdependence seems to be to go into the depth of the woods and stay there, and, of course, getting there would be impossible without the coöperation of others. It therefore seems clear that we have long since passed the day where we can utterly disregard the other fellow.

I Could Not Become Angry

Having firmly fixed in my own mind the fact that I am simply the representative *pro tem* of Mr. Edison, so far as my particular department is concerned, I can approach my dealings with workers in the department with a better understanding of what to do and what not to do. As I am simply the agent of another there is no reason in the world why I should become incensed over anything. A worker of strong personality may assert himself in a vigorous manner which I may not clearly understand and may resent. Before acting, however, I realize that I am not doing my work as a personal matter but am acting for another, therefore the words of the worker are not directed to me, no matter what he may say. They are simply directed to what I stand for. He may also be lacking in understanding of his status, so that I am not warranted in getting mad and losing my temper.

It seems that the only man in the whole establishment who is warranted in resenting such an affront is the actual head of the business himself. I soon realize, however, that his resentment would not be the kind with which I am most familiar, if indicated at all, so that I soon find that I can not justify failure to carry the responsibilities of my department on a strictly impersonal basis. It seems clear that there is no place in industrial troubles for personalities and that I should not under any circumstances waste energy but on the contrary, should use it. Not in the manner most familiar to us, however, but very carefully, considering it a precious working tool. I realize that my patience may be sorely tried, but at all times hold in mind that after all it is not my own patience that is being tried, but that of the enterprise, and therefore I am not warranted in letting my own personality lose control of itself and do something that I will be sorry for afterward.

In the analysis of my job I find that the old saying of "Whom the Gods would destroy they first make mad" is quite true, and as I do not wish to be destroyed, I decide that I will not lose control of my temper. I find that no matter how serious the situation may be, a cool head works out of it with the least difficulty, while the hot head blows up and soon occupies the status in the business comparable with the cypher with the ring rubbed out.

I Would Be a Salesman of Policy

I would hold in mind at all times that I am a salesman, and that my wares are the policy of the enterprise. I am endeavoring to sell this policy to the workers, in order that they may use it as one element in their job in turning out the products of the plant. I would keep the sales idea uppermost in mind at all times, knowing that it is better to get results from other men when they are thoroughly sold, than through a direct command without an explanation. Of course, I would not carry this to an extreme, but would point out to men the reasons why, as the first step and as an appeal to the best that is in them.

I would realize that the largest part of my job is *human relations*, and would be on the alert at all times for new ideas that would assist me in securing better results from those for whose activities I am responsible. If I am ever in doubt as to just how to proceed in dealing with another man, I would stop and think how a salesman would handle the situation if he were on the road and ran upon a similar condition. I would then endeavor to apply the sales idea to my own situation, holding in mind that it is of little avail to sell a man in the first instance, without regard to future relations. I would endeavor so to handle the transaction that he would continue to do business for years to come and would consider that the selling of the article was an incident and that I was primarily out to establish a connection which would be of mutual benefit over a long period of time. I would endeavor to hold in mind that sales are consummated because two parties agree upon a certain thing and in the right spirit. I would then find that my dealings with those for whom I am responsible would be on a better basis, as I would have in mind not only to-day, this hour, but to-morrow, next week, next month, and years to come. After all, the world is large, and the particular problem plays a small part in it. There is no use in changing the destinies of two lives over some matter that may appear of tremendous importance at the moment yet be only insignificant in the general scheme of things.

I Would Be Patient

I would consider that patience is indeed a virtue. My everyday experiences soon prove that where I am almost on the verge of expressing myself very forcibly upon an important question, and then do not do so, it would have been a great error to have done so, and that after all I profited personally by being patient and following another course. I would see that it is necessary for a man in a supervisory position to have a thick skin, into which the little things of everyday life will not penetrate. I would not let petty murmurings of disgruntled workers with fancied grievances worry me, but would endeavor to reform them from within, rather than force a change upon them from without.

I would consider an open mind one of my important attributes. The times indicate that we do business from day to day and that plans not successful in former years now accomplish tremendous improvements. I would realize that prodction is a problem in co-ordinating a large number of objects and influences, and that a particular method which might have been a failure in former years might now fit in because of changed conditions. I would not try to run a six figure business with three-figure methods.

I Would Study Materials, Machines and Labor

Knowing that times have changed, I would endeavor to keep in touch with the market for materials used in my particular department, as well as with the labor market. As production in a large organization is very much a matter of co-ordination, I would devote the same study to the use of men and materials that I would to my position in the chain of production represented by the several departments through which the materials flow.

If I were in charge of a machine shop using highly skilled mechanics, and I observed that the labor markets were tightening up so far as my particular kind of men was concerned, I would immediately look into my training facilities, with a view of improving results secured from present force, and at the same time would analyze the jobs more carefully, with the view of not using an all around machinist where a milling machine hand or some other machine operator would be sufficient. I would endeavor to hold in mind at all times that the use of materials and labor is for the purpose of making money, remembering all the considerations that should surround it, and would carefully balance the market situation against my use of these two items.

I Would Study Production and Labor Turnover

Production per dollar of pay-roll would be another item that would receive my constant attention. I would consider it a final summing up of the results secured from individual activities in my department and as a measure of results and would watch it carefully, ascertaining the reason for every change of any importance, and starting the necessary action to correct wrong conditions.

Labor turn-over would receive my constant attention. I would realize that it cost large sums of money to find the right man in the first instance, still larger sums to train him to produce the results desired, and then, having reached the production stage, that I have an investment in him which cannot be wiped out without loss. I would be particularly watchful to see that men are so placed with relation to other workers that they could work harmoniously and thus avoid the many changes that result from trying to fuse together two personalities that will not fuse.

I would observe that planning ahead would reduce my labor turn-over, and I would endeavor not to place the enterprise in the position of having to lay a man off. Giving the employment office advance notice of a reduction in the schedule when releasing men, would enable them to place the men elsewhere, and, except in times of the most severe depression, enable them to place that man so that the particular enterprise would not lose the benefit of his experience in it up to that time. In this way I would do my part in creating a feeling among workers that the plant takes care of its people and that it does not regard them as mere machines to be used when needed and discarded without feeling when the need becomes less acute. I would encourage the men under my supervision to give advance notice of any condition that might require them to be absent or to leave the department, knowing that with this advance notice I can plan to cover myself in a manner that will not interrupt production and thus reflect unfavorably in my production.

I would have a careful record of the time lost by persons on direct production kept and discuss the reasons with the individuals concerned when it appeared necessary and try to improve matters.

I Would Develop Men.

I would watch my working force and always be on the alert for unusual workers. I would see that from the standpoint of the business as a whole it is tremendously important at all times to hold forth all possible incentives to men and women, and would appreciate that promotion is one of the greatest incentives that can be offered anyone. Having that in mind, I would not object to the transfer of excellent men, but would rather pride myself on my ability to develop good men and try to be in the position of always having material for better positions ready when the opportunity presented itself. I would consider developing men one of the most pleasant features of my work, and would take great pleasure in seeing those at work under my supervision passed on to more important work.

I would be an optimist at all time, and endeavor to develop the feeling of individual responsibility as generally as possible rather than center it entirely on my shoulders. I would appeal to the pride of men and women to get results, and would go very slowly on severe criticism of mistakes, but very strongly on appreciation of and enthusiasm for good work. When someone under my supervision did something in an unusual manner, or established a record, I would see that it became known generally.

I Would Not Slight Paper Work.

One of the other general considerations that would receive my careful attention would be the various reports or paper work necessary to tie in my particular department with the main activities of the enterprise. I would realize that the only reason I make a requisition on the stock room, which is a separate department, is that the business is large enough to warrant having a specialist in stock, and that he is simply acting for me in taking care of the material in question. I would appreciate that the stock keeper cannot act with the greatest degree of intelligence and with the best results unless I do my part. I would therefore see that all of my requisitions were carefully filled out and that the specifications were sufficiently complete so that I would clearly understand them if I were in his position. So far as accounts were concerned, I would endeavor to make reports that would be [illegible] complete in order that the information might come back to me in concentrated form, and with due [illegible] to the other factors in the business.

I Would [illegible]

After carefully [illegible] the [illegible] considerations, I would then [illegible] study of the specific duties of a foreman. By analyzing the subject, I would see that they would hinge mainly around securing definite results from the work of others, and would therefore come within two main classes: 1, Instruction; 2, Supervision. I would see that to secure the results the business requires, my main job is production, and I would forget how business was conducted in former years, would let the purchasing agent do the purchasing, the storekeeper the storing, and the employment man the employing.

So far as instruction is concerned, the enterprise having a training room, I would be glad to delegate that responsibility to those in charge of the training room, making certain, however, that the worker sent to me has been properly trained for my work and that any further training necessary to make a skilled operator on my particular job is given in my own organization. In other words, I would realize the difference between actual training and adjusting to the work of my department. I would particularly endeavor to cause the newcomer to feel at home, having in mind that the labor turnover is largest among those in our employ a month or less.

I would make certain that the worker clearly understands the part his particular job plays in the final production of the plant. If it were the manufacture of storage batteries and he were on an assembling operation, I would show him just what part the particular sections assembled by him played in the battery, what would be the effect of poor work, the importance of being on the alert at all times for defects, what the storage battery is used for after it is a finished product, and its general status in the electrical field. I would preach quality at all times, that accuracy comes first and speed next.

I would see that my instruction extended further than the actual work on which the person was engaged, and that it covered the method of reaching the department, what to do in case of fire, and all the other little details outside of actual production that go to make one feel at home and part of the department. I would particularly hold before me the thought that the first few days or weeks in the department is the most trying time for a worker, and would give him special thought and attention during that period, with the idea of helping him over the rough spots as much as possible.

I Would Properly Supervise.

Having instructed him, I would then come to the question of supervision, and would realize that the main elements in supervision are covered by the following five words:

Plan—Schedule—Execute—Measure—Reward

I would endeavor to cover as much ground as possible and watch the points where the trouble is most apt to occur. In starting a new job, I would naturally watch those performing the initial steps after having gone over the plans carefully. If my working force were large I would appoint a sufficient number of assistants to make sure that supervision was beyond reproach, realizing that the average American industry to-day is over-equipped and under-supervised.

I would keep those two words: 1, Instruct; 2, Supervise, before me constantly as the big idea.

There are probably many things not enumerated here that I would do, but I would always be guided by the thought that I am acting [illegible] as [illegible] he would do.

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

First Epoch of A New Profession

By Meyer Bloomfield

Mr. Bloomfield, *industrial expert, for the past year Chief of the Industrial Service work of the United States Shipping Board Emergency Fleet Corporation, is the founder of the employment management movement and profession.*—The Editors.

EIGHT years ago the Employment Managers Association was started in Boston, the first organization of its kind in the country. In the city of Rochester, New York, there was held during the middle of May, 1918, a national convention of employment managers, attended by over 600 delegates. Probably as many as 20 employment managers' societies were represented in that company.

This convention properly marks a turning point in a new movement and a new profession. More than any other influence, the world war has been the most potent factor in making the employment manager come into his own. And this is because the husbanding of our man-power resources is the most urgent of all our industrial problems.

The Boston association was started with a very simple purpose in view. Men who have the duty of building up a working force in an establishment, who do the hiring, recruiting of labor, selecting employees for various tasks, are engaged in a work of the highest importance to industry and to society. On their qualifications, outlook, understanding, responsibilities and power, the very nature of the organization for which they work finally depends. Industrial conditions of the present make this fact doubly sure.

The Boston idea was to bring a professional consciousness into the work of building up and maintaining a working force. The method adopted to give this idea form was also simple. A small group of men engaged or interested in employment questions were invited to meet regularly and think aloud about their common problems. There was need of a common point of contact, because no other society gave special attention to such questions, and employment officials were seldom members of associations which were interested in or had given attention to their particular problems.

National Conferences

It was certain that once such a group met systematically, and began to analyze their common experiences, valuable by-products were sure to flow. But the beginnings were not easy. While there were highly competent employment men at work, some of them strongly backed by their far-sighted employers, the general conception of employment work was such as to make a regular organization for this purpose seem somewhat needless and theoretical. So, out of the original 50 men invited to join, a mere handful remained after a year or two. These men met and discussed their work and difficulties. This nucleus stuck right through and made possible the present large membership of something like 200. But meanwhile the idea got abroad; Philadelphia was interested, and under the leadership of an excellent body of employers and professional men a strong society resulted. Then came Detroit, San Francisco, Chicago, and other cities.

National conferences became possible within the past four years; Minneapolis, Boston, Indianapolis, Philadelphia, and finally Rochester, saw the gradual culmination of a nation-wide expression of interest in this movement.

Early in this work the professional basis for this function of management was under consideration. As in the case of nearly every other profession, which once had very humble beginnings, it was realized that systematic training for this work was the secret of lifting the daily routine of employment to its proper managerial level.

Dartmouth College was the first to receive this suggestion with characteristic sympathy and energy. Under President E. M. Hopkins and Dean H. S. Person, men imbued with a vision of modern management, the first training course for employment management was instituted. Later, the Wharton School of the University of Pennsylvania, and other excellent centers of professional training, took up the work and made distinctive contributions to its advancement.

The present war has seen a notable extension of employment management courses, given intensively and on an emergency basis. Rochester and Harvard Universities have been in the forefront of such training, to the great benefit of the nation's shipyards, munition and other plants.

The professional preparation then of the employment specialist, university recognition of this service, and a large expansion of this movement, accelerated by the war, are among the fruits of the first epoch. There are other interesting developments. In the first place, a new industrial literature on this subject has grown up. Eight years ago there was probably not a word to be found on this subject. Recent bibliographies, particularly the excellent pamphlet on this and kindred topics published by the Harvard University Department of Education, give scores of important references.

Reaction on the Executives

No outgrowth has been more interesting than the reaction of employment management on other executive functions. The one of most interest to those who have been active in this work is the conception of a new foremanship required by present day conditions. Credit for stimulating this conception and giving it concrete form is due among others to the managers of the International Harvester Company, who have put their efficient organization to the tryout of some fundamental policies.

On the whole, it may be said that while the growth of the employment management profession and movement, from an obscure and rather unpromising beginning eight years ago, has been rapid, yet it has not been abnormal. Industry was ripe for the venture.

The new profession, then, has arrived. But lest some be lulled into dangerous self-compl'acency, it is important to point out that when any organism comes into being the only problem solved is merely that of its creation—a host of problems connected with its vitality and longevity spring up.

What is the outlook? Here is a new resource in industrial life. Strong executives are giving this work and profession their invaluable support. It is reasonably certain that the coming decade will see even more striking developments in this field of management—it is the duty of those who have been interested in the employment management profession to perfect the technique and instrumentalities of service; it is especially incumbent upon them to prepare for the next step, to make new trials, learn new lessons, and enrich the scope of helpfulness even yet latent in this vocation. The possibilities of service in this profession are attracting strong men and women.

Rest Rooms and Their Influence on Application to Work

By L. H. Butler

With The Goodyear Tire and Rubber Company

INDUSTRIAL efficiency is dependent on so many seemingly small phases that to attain it in the highest possible degree is a complex problem that ramifies into innumerable alleyways of doubt and difficulty.

I once heard a man, who has interested himself in industrial welfare work on a scale national in its scope, say that employees will not stand for coddling if they have any backbone in them at all, and that most of the social service work done among them to-day was of such a character that it defeated its own purpose. This man affirmed that much welfare work was of this "coddling" type, presented to the employee in a tactless, self-praising way that engendered an undercurrent of suspicion. The employee so "coddled" fears the ulterior motive and his mind loses much of its power to concentrate.

EMPLOYEES' REST ROOM IN A MODERN FACTORY

One feature of industrial social service work that requires careful promotion is the rest room. More adaptable to female employees than male, unless tactfully handled it can arouse fully as many doubts in the employee's mind as other forms of welfare work. One firm in the middle west that employs 500 girls in its general offices planned such a venture in connection with a medical supervision department, and overcame any unpleasant difficulty by keeping the venture a secret until the room was ready for use.

A Social Worker Can Develop Enthusiasm

One of the first things this social worker did was to see that a girl from each department was appointed on an entertainment committee to confer with her in planning parties and other entertainments for the different groups of girls—the groups being determined by departments. Naturally in this way a great deal of rivalry sprung up between the departments which was used to advantage by the social worker to develop enthusiasm.

The plan was a considerable success, for the girls were quick to catch the spirit of the parties. They were not bound by irksome conventions or hedging restrictions, and this went a great ways toward making the girls feel that the room belonged to them. It gave them that sense of freedom so essential to secure the girls' coöperation in the social program. The social organizer gained the complete confidence of the girls, not only because she was replete with original ideas for amusing and entertaining—she always entered into the merriment of their parties as if she was one of them—but also because her whole-hearted interest in their plans was sincere and constructive.

The results of this plan at the end of six months were so noticeably beneficial, not only to the company but to the girls, that it was acknowledged a far greater success than at first was considered possible. One way in which this firm checked the results of the rest room experiment was to sound the loyalty of the organization through a series of talks on the company's policies, given to the girls by one of the executives. The girls caught the inspiration and enthusiasm of the speaker far more readily than they had before the rest room became a reality.

More than 90 per cent. of the female employees who came into this organization, or were in it during the first three months of the rest room trial, were there at the end of the sixth month. Previous to this there had seemed to be an apparent—and almost constant labor unrest that caused a continued influx of new employees.

Many industrial organizations, after having tried out the rest room idea on an inadequate scale, have renounced it as an extravagant and futile wastage of money. In some respects those concerns remind me of the man who hunted bear with bird shot; they had the idea, they knew what they were going after, but they were not equipped to do the objective full justice, and because they did not get the results they expected with the inadequate equipment, they decided that the whole idea was wrong.

When the novelty of a rest room wears off the investment might as well be charged off to profit and loss account, for on the interest the girls take in it depends the results that prevent it from becoming a dead issue and a wastage of money. In this respect the rest room is not unlike other interests that require constant developing to become producers. The investment, once made, should be worked just as thoroughly and consistently as an investment entailing more tangible returns, for the rest room has in it some great possibilities for reducing overhead, and that, after all, is only an interchangeable term for "increasing profits."

A club-like atmosphere, a harmonious environment, gives to an industrial rest room its attractiveness, and girls in the working classes are just as human as girls in other classes.

Editorials and Comment

Pitiless Publicity in Business

MR. H. L. GANTT in his testimony before the Federal Trade Commission called for the breaking down of secrecy in business and for the fullest publicity in regard to business dealings. In this respect he has sounded a new note and has called attention to another procedure that must be put into effect for the benefit of the people as a whole.

And how plain it all is once it is pointed out to us! So long as business is done behind closed doors with drawn curtains and a wad of paper in the keyhole, just so long must the public stand for whatever business puts over. From a den of secrecy business men pipe and the public must dance or, according to the modern method, pay honest-earned dollars for concealed inefficiency, mismanagement, idleness and waste.

Once we have pitiless publicity in business no one would be able to capitalize losses. Just see the significance of this question and answer from Mr. Gantt's testimony:

Q. State whether or not in your opinion it is proper to capitalize losses in the first three years of business of a manufacturing plant for the purpose of securing profits or returns?
A. It would be a very bad precedent to allow anybody to capitalize losses.

Once we have publicity in business affairs no one will be able to secure allowances for excess valuation. Just consider the following question and answer:

Q. State whether or not with respect to timber properties owned by the manufacturers or held by them under lease or license, allowance should be made in this proceeding for a valuation of such properties beyond the actual amount that the manufacturers have spent for acquiring, maintaining and improving said property?
A. No allowance in excess of what you stated should be made.

Once we have publicity in business affairs no one would be able to load his "manufacturing cost" with expenses that are not properly comprehended in that cost. Mr. Gantt clearly defines what should be included in manufacturing costs in the two answers given below:

Q. What is embraced in your term "manufacturing cost?"
A. Total expense incurred for placing the raw material in the factory, the actual labor incurred in converting it, that portion of the overhead expense necessary to operate that labor.
Q. You do not mean to say that you limit overhead simply to the part of overhead expense necessary to operate the conversion of that labor?
A. Yes.

The right of the public to have manufacturing costs investigated and a selling price fixed which will not pay a premium on inefficiency is brought out forcibly in this question and answer:

Q. If I am manufacturing a product, although I am inefficient, and the market is demanding that product and is ready to buy it from me, are you going to advise me as your client to sell it to the market at a price less these items or include those items?
A. I would not advise you, but I would advise the Federal Trade Commission to fix a price so you could not do it.

In the following four answers Mr. Gantt declares his belief that more business would be done if publicity was given to costs and if these were intelligently scrutinized by the customer before purchasing.

A. * * * I say you put all of these items on the table and let everybody see what they are, and there will be no difficulty in deciding which ones should be included in the selling price and which not.
Q. Do you know any manufacturer who lays all of his costs on the table every time he solicits a customer?
A. No, but I think it would be a good thing if he did.
Q. How much business do you think would be conducted if the customer intelligently scrutinized the cost?
A. I think a great deal of business. I think that if that was the habit in the country rather than the present habit, that business would improve tremendously. Lawyers would go out of business.
Q. That would be the greatest good that the country could have, I think, if they would get rid of lawyers and efficiency experts, and business would be splendidly run.
A. No question about that. You see, it would make it so much easier for the Federal Trade Commission if you put these out without having them drag them out.

And, finally, Mr. Gantt expressed his belief that business would have been much more successful in the past, and will be much more successful in the future, if business is *controlled in the interest of the community*

A. As I said I preferred the business men should control the business, but if they controlled it in the interest of the community, and not in the interest of a few, it would have been very much more successful than it has been.

Production At Standard Cost Or Not At All

HAS the manufacturer any right to compel the public, the consumers, to pay high prices for commodities merely because inefficiency and mismanagement carry the cost of production beyond the practical standard cost within the attainment of the manufacturing equipment and the workers? Or, putting it the other way around, the public has a right to purchase commodities whose manufacturing cost has not been increased by a burden of inefficiency and waste.

These rights are plainly declared in the five principles presented in the testimony of Mr. C. E. Knoeppel, before the Federal Trade Commission, see page 8.

This principle is right.

This principle must be applied in American business.

And the very foundations of our business and manufacturing structure will be shaken once this principle is applied.

Inefficiency, mismanagement, idleness and waste must go never to return. They must go at once to enable this great nation to exert its power in winning the war; they must be eliminated forever to permit the unhampered development of our economic life during the forthcoming years of peace. But the intent of this principle is inexorable. Either the manufacturer will produce his commodities within the standard cost for those articles, or else he must go out of business or turn the management of his plant over to others. No other alternatives can be considered.

This is strong doctrine for strong men.

Why More Shipways?

DIRECTOR GENERAL SCHWAB of the Emergency Fleet Corporation has recently stated that we must build more shipways in order to produce the great floating bridge between this country and Europe. He has stated also that by October of this year two 10,000-ton ships will be launched every day.

From a speech made in South Bend, Indiana, on June 10, Chairman Hurley of the Shipping Board stated that the merchant shipping output this year would exceed 3,000,000 dead weight tons, and that our new shipbuilding industry would be capable of turning out 13,518,000 tons during the year 1919.

But let us calculate just a little.

We all recall that the *Tuckahoe,* a 5,500-ton steel freighter, was completed in Camden, New Jersey, from the laying of the keel to launching, in 27 days. Ten days later she was delivered to the United States Government.

Now the rate of building the *Tuckahoe,* a 5,500-ton vessel in 27 days, was a trifle over 200 tons per day. Let us multiply this factor of 200 tons per day by 365 days and we have the possible output per shipway, based on the *Tuckahoe* record, of 73,000 tons per shipway per year.

Chairman Hurley in the address referred to above stated that the Emergency Fleet Corporation has 751 shipways to be utilized for the building of American merchant ships. Let us multiply 73,000 by 751, and we have the surprising total of 54,823,000.

That is, if each one of the 751 shipways building ships for the Emergency Fleet Corporation should produce vessels at the rate at which the *Tuckahoe* was completed, the possible output per year would be the stupendous amount of over 54,000,000 tons.

Over against this let us set the 3,000,000 tons which Mr. Hurley promises will be complete this year, and the slightly more than 13,000,000 tons that he states the yards will be capable of turning out next year. These expectations are so far below the apparent possibility based on the *Tuckahoe* performance that one begins to wonder why the discrepancy is so great, and why any more shipways are needed.

It really looks as if the job was not building more shipways but finding out how to utilize more effectively those that we have. Perhaps the point of attack is not in the shipyards anyway, but in the factories fabricating the steel for the hulls and building the engines and boilers, that is in the shops and mills producing the materials that are put together at the yards.

Lest any one think that the building of the *Tuckahoe* was merely a stunt, it is wise to quote that old maxim, "What man has done man can do."

Why Pay for Idleness?

SUPPOSE you hired a man to mow your lawn this summer. Suppose you agreed to pay him 40 cents an hour, and the first time he mows it he does it well in four hours. Then you must pay him $1.60. Suppose also that you happen to be sitting on your porch the second time he mows it and you note that he is "on the job" for six hours, during four of which he mows your lawn, and during the other two he loafs, is idle. At the end of six hours he comes to you and asks for $2.40. In return for that sum he has given you four hours of work, which according to your agreement are worth $1.60, and is attempting to capitalize two hours of idleness at the same rate.

Are you going to pay 80 cents for those two hours of idleness?

From this homely illustration let us turn to the manufacturing plant that has thousands of dollars worth of idle equipment that might produce but is not producing and ask this question: Are you going to pay an increased price for the goods produced in that factory because of the idleness of the equipment? You objected to paying the man who mows your lawn for two hours of loafing. Then, if you are consistent and looking out for your interests and the interest of your community, you must likewise object to paying the increased cost of commodities due to idleness in the plant that turns them out. You cannot escape this course of action.

The following excerpts are taken from the testimony of Mr. H. L. Gantt before the Federal Trade Commis sion and deal most pointedly with this matter of idle expense.

Idleness finally means loss of market.

> A. Some people prefer to see how much that they can charge back to the consumer, but those who charge that back to the consumer in a competitive business will very soon have no idle expenses at all.
> Q. Why?
> A. Because they will sell at a lower price, for competition will result in the man who has the lowest cost and can afford to sell at the lowest price—he will gradually fill up his plant while the man who insists on charging for his idleness will have a higher cost of manufacture and thereby be cut out of the market.

Whatever does not help to produce goods is idleness.

> Q. State whether or not similar expenses of the International Paper Company and other manufacturers in January, February, and March, by reason of the shutdown of mills on the order of the Fuel Administrator of the United States Government, and similar orders of Government officials in Canada, should be charged to the cost of production on days or periods when the mills were operated?
> A. Inasmuch as during that idleness it did not help to produce goods, certainly not.

Idleness must be eliminated.

> A. The fact that we are inefficient is no excuse for us remaining so. That is the point.
> But it is a fact, however?
> A. Yes, but we cannot live on that fact any longer. We have got to stop. We have come to the end of that. We have got to begin to eliminate our inefficiency, if we want to fight a country that has eliminated a large number of them.

The way to begin to eliminate idleness in the manufacturing business of this country is for each one of us to refuse absolutely to pay for the increased cost of commodities due to idleness.

What Is Americanization?

PERHAPS the clearest statement of the meaning of the term Americanization, and the most comprehensive outline of the agencies that are working for Americanization in this country are combined in a report made by Mr. Charles H. Paul for The Solvay Process Company. This report is the outcome of a survey made by the company in question, during which a careful investigation was undertaken of a selected number of educational agencies which were thoroughly representative of the work being done in various industrial localities. These localities were in the states of Massachusetts, Rhode Island, Pennsylvania, New York, Ohio and Michigan.

The real aim of Americanization has been befogged and beclouded by many speakers and writers for the reason that the issues have been confused with the older forms of paternalistic welfare service. It is therefore refreshing to discover that Mr. Paul has at once reached to the core of the subject when he outlines the aim of Americanization as including the following three elements:

1. The teaching of English.
2. Definite preparation for taking out papers in citizenship.
3. Preparation of the individual for larger expression of himself in his home, his work and his community.

The best of all Americanization work that has been done has comprehended these three elements.

With equal recognition of essentials Mr. Paul lists the four types of agencies which are offering education to non-Americans as:

1. Young Men's Christian Associations and other public institutions.
2. Local Boards of Education.
3. State Boards of Education.
4. Local Industries.

In regard to the Young Men's Christian Association he has this to say:

> The Y. M. C. A. still is the most characteristic agency for Americanization in states like the Atlantic coast and its work extends inland to communities where large numbers of non-Americans have congregated. There is at present no other directing agency which appreciates the many sided aspect of Americanization as the Y. M. C. A.

And again:

> The Y. M. C. A. undertakes its work with a very distinctive social aim. The Public and State School Boards have a background of educational experience which should never be ignored. The industry makes a demand for the highest degree of efficiency in the education of its employees, and furthermore, offers the mechanism for uniting educational work with safety and welfare work. It is this three-phased aim in Americanization work which will prove most effective.

As printed the report is comprised in a booklet of 37 pages and takes up methods of administering education in industry, methods of securing attendance, the location and equipment of school buildings, the teaching staff, courses of study, relation of the English school to the other activities of industry, the reaction of Americanization on labor and, finally, a series of definite recommendations which were prepared particularly for The Solvay Process Company. Any one who is connected with the work of Americanization will be helped by obtaining a copy of this booklet.

Women As Employment Managers

A DEFINITE decision has recently been reached to the effect that women will now be admitted to the courses in employment management being given at the University of Rochester, and at Harvard University. The basis for admission will be the same as for men. Each applicant must be not less than 25 years of age; must have at least a high school education and have had three years' actual experience in a factory.

It is gratifying to realize that the profession of employment manager is now definitely open to women. Without doubt in some of the aspects of labor maintenance women can and will excel.

Factory Equipment News

The Latest Labor-Saving Machinery

Improvement in Dump Car Construction

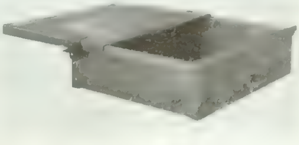
The accompanying illustration shows an innovation in the construction of a V-shaped, double-side dump car of the rocker or cradle type. It has a capacity of one cubic yard. The body inside is reinforced to lessen the wearing action of the material handled. The frame is of standard construction, being of the round bumper type with wide flanged channels. The wheels are of cast steel with flexible roller bearings. This car is a recent product of the Orenstein Arthur Koppel Company, Koppel, Pennsylvania.

IMPROVED DOUBLE-SIDE DUMP CAR

All-Steel Bench Drawer

THE New Britain all-steel bench drawer has been designed to meet factory requirements where the wooden back, bottom and front are unnecessary. The upper edge is triple hemmed to provide stiffness, and all of the joints are welded.

A feature designed to do away with the annoyance of pilfering is a solid sheet metal top which prohibits tampering with the rear of the drawer and prevents blocking or a "lockout" through wedging of the contents. It also serves to exclude oil or water that might accidentally run through from above. The side ways are integral with the top. The handle is generous in size and designed to give a comfortable handhold. The lock is of the cylinder type, fitted with two individual keys. If desired, a master key system can be provided.



[illegible]

The drawer is sold as a unit requiring no fitting to install. The inside dimensions are 18 inches long, 16 inches front to back, and 5 inches deep. It is manufactured by the New Britain Machine Company, New Britain, Conn.

An Industrial Tractor

The Industrial Truck Company, Holyoke, Massachusetts, manufactures two types of industrial tractors; one having end control and the other center control. The second type of machine is one where the operator sits in the center and can, by changing seats, operate in either direction without having to turn his tractor around. In narrow congested factory aisles this is often a valuable feature. Either type steers on all four wheels and is built as a two or four-wheel drive. The two-wheel drive machine can be converted into a four-wheel drive by adding the necessary worm and wheel housings, differential and a few other parts.

NEW INDUSTRIAL TRACTOR

The frame of this tractor is built of commercial, rolled, channel section steel; the bumper plates are boiler plate bent and riveted to the frame. The coupler castings are of the three-step type to accommodate different heights of trailers. The battery boxes are removable by side doors, and hinged top plates afford easy access for flushing and inspection.

Any type of battery can be supplied up to a maximum of 42 cells A8 Edison, or 24 cells 21-plate lead. Power is transmitted to the motor through a single reduction worm and gear down through a differential to the wheels by means of a universal joint capable of operating at an angle of 43 degrees. This joint is enclosed in a dust and oil proof case. The wheels are provided with ball bearings. Two separate brakes are provided, the one operated by the left foot is an emergency and the other by the right foot is a service brake.

To operate the tractor the driver must sit in the seat with his left foot pressing the emergency brake down. Every time his left foot is lifted from the brake pedal the brake is applied, bringing the machine to a stop and, by means of a clutch on the controller shaft, throwing the controller handle out of gear and the controller to neutral. Under these conditions it is impossible to start the machine again without first releasing the emergency brake and bringing the controller handle back to neutral.

In addition to these safety features the steering wheel tilts. That is, the wheel is so located that the operator must tilt the wheel in order to leave his seat. This tilting device is interlocked with a controller shaft clutch so that under no conditions can the battery current be applied until the wheel is in a proper running position.

Suspended Platform Construction for Scales

The Bennington Scale Company of Bennington, Vermont, has developed during the past few years a suspended platform principle for weighing machines. The purpose has been to produce an arrangement and construction affording ample protection of the pivots and bearings against wear and corrosion.

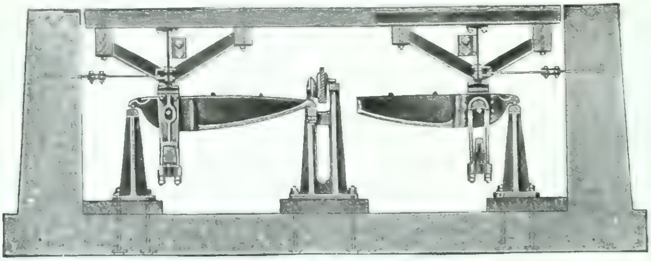


FIG. 1. BENNINGTON SUSPENDED PLATFORM SCALE

Figure 1 herewith shows the Bennington suspended platform heavy duty or auto truck scale, and Figure 2 gives details of the suspended platform principle. The load on the scale is transmitted from the platform indirectly to the weighing mechanism as the load is suspended from the load-receiving pivots instead of being applied to these pivots directly. By this construction the shock of loading the scale is eliminated, together with lateral motion and grinding.

The type of mechanism shown in Figure 1 is especially adapted for service where automobiles are in use, and for heavy team weighing. Referring to Figure 2, the foot of the bracket shown as 1 is attached to the effective platform. The lower ends of this bracket engage opposite ends of arm 6. The steel surface of 3 engages the opposed continuous knife-edge surface of the load-receiving pivot which passes through the walls and bridges the opening in arm 5. The lower end of the bent strap 2 passes through holes in the clamp 10 and is fastened by means of nuts and lock nuts.

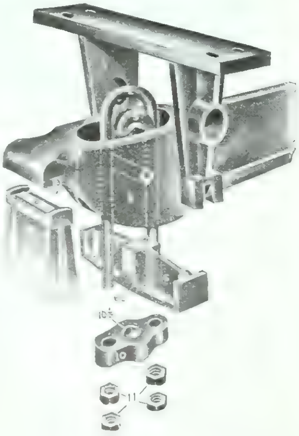


FIG. 2. DETAILS OF MECHANISM

The bracket 6 and clamp 10 formed a universal joint, for when assembled the semi-spherical projection indicated as 10½ enters a depression indicated as 6½ in part 6. This mating permits of a universal movement through the point when all action from the platform is transmitted to part 1. The support 9, the butt or fulcrum pivot, has a continuous knife-edge which engages the full and uninterrupted surface of the continuous steel bearing 8. This pivot bearing is housed in a recess in the top of the fulcrum stand 7. Owing to the arrangement of these parts it is possible to pack the pivots and bearings in grease as a protection against corrosion.

Horizontal Plate Bending Roll

The accompanying illustration shows a large set of bending rolls recently built in the Niles Works, Hamilton, Ohio, of the Niles-Bement Pond Company. This machine is of the strongback type and has a capacity to roll mild steel plates 1 inch thick by 36 feet long, and 1¼ inches thick by 30 feet long.

In construction the machine consists of two heavy cast-iron housings, united at the top by two 20-inch I-beams and at the botom by two heavy cast-iron side frames with bearings for eight pairs of steel rollers, four pairs on each side support the lower rolls. The three rolls, are forged steel arranged as one upper and two lower, each having a length of 36 feet and 9 inches between the journals. The lower rolls are 16 inches in diameter, the top roll is 19 inches in diameter, and is reinforced by a built-up steel girder carrying on its undersides four supporting roller bearings located directly over the bearings carried on the side frames below. The girder and roll are raised and lowered by means of a steel screw at either end. These screws are operated by a 75 horse power motor so arranged through mechanism

NILES-BEMENT POND BENDING ROLL

that each end of the roll may be raised or lowered or both may be raised together.

The rolls themselves are driven by a 100 horse power motor. The operating handles are grouped together in a convenient location at the motor end of the machine, so that the motor controllers, reversing and clutch levers can be handled by one operator without moving from his position on the operating platform. The machine is supplied with four top braced jib cranes, self-contained with the machine. The posts for the cranes are at the four corners of the machine.

An Enclosed Crane

A completely enclosed crane has recently been installed in the Cuyahoga works of the American Steel & Wire Company by the Shepard Electric Crane & Hoist Company, of Montour Falls, N. Y. It has a span of 76 feet 8 inches, and is of 10 tons capacity. It is adapted to the use of an electro magnet. Figure 1 shows a general view of several of the enclosing features. Figures 2 and 3 show details, of which the first is the enclosure for an intermediate bracket without coupling, and the second a bracket where there is a coupling. From these illustrations it will be seen that the cast ends are clamped directly to the bearings. A boiler tube is fitted into these end pieces with a sufficient bearing so that there will be a little tendency for the enclosure to get noisy under the conditions of hard usage.

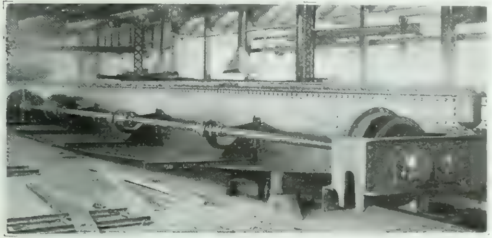


FIG. 1. SHEPARD ENCLOSED CRANE

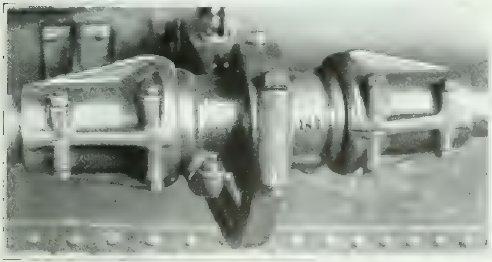


FIG. 2. DETAIL OF CRANE

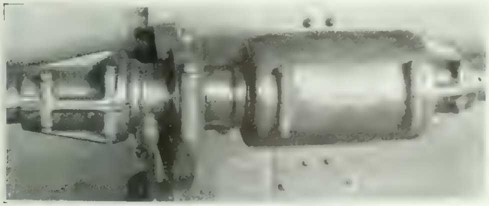


FIG. 3. BRACKET WITH COUPLING

Extension Boring and Turning Mill

The accompanying illustrations, Figures 1 and 2, show a 28 to 42-foot extension boring and turning mill recently built for arsenal work by the Niles-Bement-Pond Company. The machine swings with the housings forward 28 feet and 2 inches, and 42 feet and 4 inches with the housings back. The maximum height under the tool-holders is 10 feet, bar travel 84 inches. The table is driven by a 60 horse power motor through a double pinion drive. A 24 horse power motor is used for elevating the crossrail, and a 15 horse power motor is used for traversing the housings. The crossrail has two heads with octagon bars 10 inches across the flats. The crossrail is 48 inches in width and 54 inches deep from front to back.

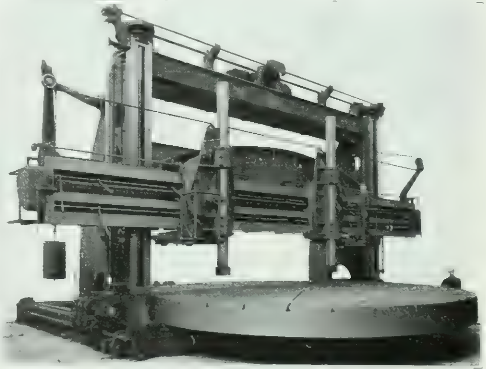


FIG. 1. WITH HOUSINGS FORWARD—28 FEET SWING

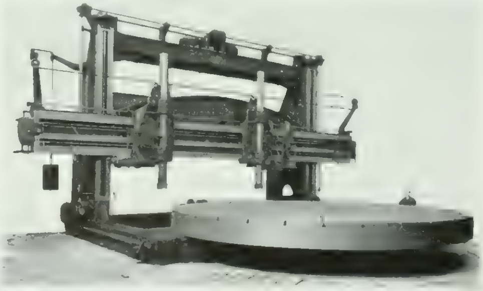
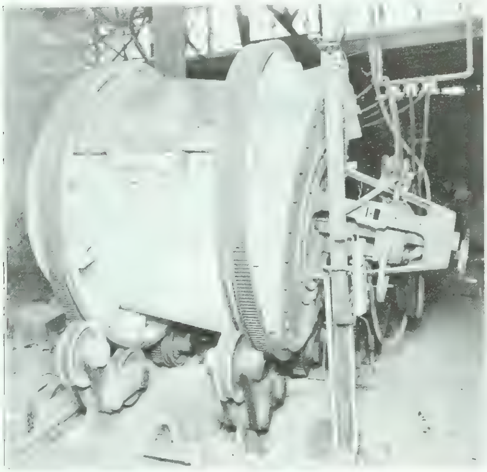


FIG. 2. WITH HOUSINGS BACK—42 FEET SWING

The table is designed to carry safely a load of 300,000 pounds (150 tons) in addition to its own weight. The table is driven by two forged steel pinions, one located on each side. Each crossrail carries an operators' platform. The adjustment for feeds, control of the rapid traverse for bars and saddles are all controlled from these locations. The motor control is through push button switches.

Rocking Electric Furnace for Brass Melting

Under the direction of the Bureau of Mines an electric melting furnace for brass manufacture has been developed and patented. Free license to operate these furnaces under the patents can be obtained by making application through Mr. Van H. Manning, Director of the Bureau of Mines. The furnace is the result of five years' experimentation by Mr. H. W. Gillett, chemist of the Bureau of Mines, in coöperation with the laboratory of Cornell University, the American Institute of Metals and a number of brass manufacturers. The accompanying illustration shows one of these furnaces.



ROCKING FURNACE FOR MELTING BRASS

The feature of the furnace is its mounting on a truck, so that it can be rocked or partially rotated during the time of melting. The rocking motion is automatic and it can be set during the beginning of a melt at what is called a "safe rock" of 80 degrees. After the charge has begun to melt this safe rock is started, the angle being such that the solid charge will not fall on the electrodes and break them. A complete oscillation on safe rock takes 13½ seconds. During this part of the process of melting the solid metal is washed about in the molten part of the charge and is tumbled over so that fresh surfaces receive direct radiation from the arc. As the melting goes on the rocking angle is increased by turning the handle of the control device from time to time until, when the metal is all melted, the furnace is on the "full rock" of about 200 degrees. On full rock the metal washes the whole circumference of the hearth save the height of the charging door and a few inches above and below it, so that metal does not splash into the door joint. A complete oscillation takes 33½ seconds.

The drum of the furnace shown in the illustration is 5 feet in diameter and 5 feet long, the lining is 12 inches thick, consisting of silocel, a special heat-insulating brick in the middle layer and corundite brick in the actual hearth lining. The hearth is 3 feet long by 3 feet in diameter, and takes charges of 1300 pounds and upward. The electrodes are 4 inches in diameter, made of graphite and threaded for continuous feed. They are adjusted by screw-operated supports of the lathe-slide type. The current required is single-phase, 60 cycle, stepped down to 120 or 130 volts; 300 k.v.a. being available. The open circuit voltage falls to about 106 to 116 volts under load. The current varies between 1000 and 2000 amperes, 1650 amperes being about the average. The power input can be varied by alternating the length of the arc, and runs from 100 to 200 kw., averaging about 165 kilowatts. The flexible leads and the water hose for electric cooling are shown in the illustration.

It is claimed that the power consumption is low for the weight of the melt, and the metal losses are likewise small. The need of a furnace for brass melting is emphasized because of the difficulty of getting graphite crucibles, owing to conditions set up by the war.

A Factory Vacuum Cleaner

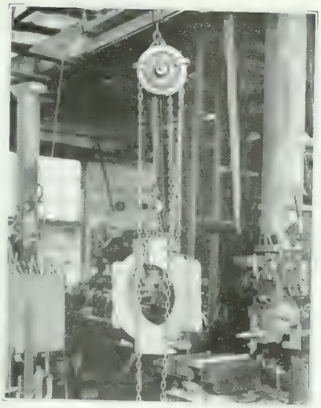
Under the trade name of "Vacuna" the Kant Vacuum Cleaner Company, Inc., Rome, New York, has put out three models of vacuum cleaners suitable for mill and factory use. The larger size known as the "Jumbo," in use in a textile mill, is illustrated herewith. The other two sizes are known as the "Standard" and "Junior."

"VACUNA," "JUMBO" VACUUM CLEANER

As will be seen from the illustration, the cleaner is of the vertical type, having but one moving unit, a single motor shaft on which two metal exhaust turbines are mounted. The ends of the shaft are supported by ball bearings packed with grease. The machine is free from gears, valves or bellows; the only moving parts to care for are the bearings and motor brushes.

Hoisting and Conveying Device

The accompanying illustration shows an installation of a simple hoisting and conveying device consisting of three elements: a track attached to the ceiling, beams or other overhead construction to support the track, and a trolley and chain block arranged to travel back and forth along the track. Taken together the device is known as the "Mechanical Helper." The photograph from which the illustration was made was taken in the plant of the Richards-Wilcox Company, Aurora, Illinois, the manufacturers of the track and carriers. The chain block shown is manufactured by the Yale & Towne Manufacturing Company.


NEW HOISTING DEVICE

This cut shows an illustration of a Mechanical Helper to serve a metal shaper. Because of the interference of overhead belts it was necessary to drop the track a considerable distance from the ceiling.

The device is a convenient one in a stock storage room, where it is frequently employed.

Personal and Business Items

The Brown Hoisting Machinery Company, Cleveland, O., announce the taking over of their San Francisco office by Mr. H. D. Wright, who becomes the manager of the firm's northwest territory.

The Crane Packing Company's New York City office has been moved to larger quarters in the Park Row Building, and Mr. Julian N. Walton has been appointed manager.

The Crane Packing Company announces the appointment of Mr. A. W. Payne as sales manager for the United States and Canada, with headquarters at the home office in Chicago.

The Smith Gas Engine Company has recently moved its office to Dayton, Ohio, where a new plant is being completed to take care of the increased demand for the firm's gas producers. The plant at Lexington, Ohio, will be kept in operation to its full capacity as at present.

Mr. Henry D. Jackson, formerly of Timothy W. Sprague and Henry D. Jackson, consulting engineers, 88 Broad Street, Boston, Massachusetts, has joined the organization of Monks and Johnson, engineers and architects, 78 Devonshire Street, Boston, as power engineer taking charge of their power plant and heating work.

The Combustion Engineering Corporation, New York, invites attention to Bulletin C1, devoted to the Coxe stoker. The bulletin contains 30 pages entirely given over to illustrations, both halftones and line drawings, showing stoker installations.

A new factory building is to be added to the manufacturing plant of the New Britain Machine Company, New Britain, Connecticut. It will be a one-story structure of brick and steel, having ground dimensions 100 x 340 feet.

Mr. V. Baudin, resident engineer for the French manufacturing organization headed by Mr. Andre Citroen, has removed his office to 21 East 40th Street, New York.

The Laclede Christy chain grate is fully illustrated and described in a catalog recently issued by the Laclede Christy Clay Products Company, St. Louis, Missouri. These stokers are intended for use with the higher volatile coals.

The Wetmore Mechanical Laboratory Company, Milwaukee, Wisconsin, has just issued a folder illustrating and describing their line of taps, reamers and special riveting and boring tools that have been developed for the manufacture of shells.

The Terry Steam Turbine Company announces the appointment of Mr. E. E. Maher as manager for the Chicago district, with offices in Chicago, and Mr. John D. Stout as manager of the New York office.

The Griscom-Russell Company, New York City, has just issued Bulletin 901, describing its multiwhirl cooler. This device for cooling lubricating oils is illustrated in detail, its uses, dimensions and sizes are listed, and full information given as to the sizes are listed, and full information given.

Mr. H. D. Savage has been elected vice president of the Locomotive Pulverized Fuel Company of New York, N. Y. Since 1917 he has been manager of sales of this company in addition to carrying on his regular duties as vice president of the American Arch Company.

The Merchant and Evans Company, Philadelphia, Pennsylvania, has just issued a bulletin devoted to "Almetl" fire doors and shutters, and to stove ventilators. The bulletin is fully illustrated, showing application, results of tests and approved construction for fire doors, shutters and factory ventilators.

Bulletin No. 5, issued by Wellman-Seaver-Morgan Company, Cleveland, Ohio, is devoted to illustrations and descriptions of the Highes Mechânical Gas Producer. The producer is shown in section, some of its working parts in detail, particular features are fully described and a list of partial users is included.

The Independence Bureau of Philadelphia has just put out a booklet under the title "Are You Cashing In On Bureau Service?" It is devoted to the matters of fire prevention, accident prevention and human relations in industry. A chart shows the forms of service that the Bureau offers and the last few pages give a list of representative clients.

The Portable Machinery Company, Inc., Passaic, New Jersey, has put out an attractive folder showing a number of representative applications of its scoop conveyor. These show the handling of coal under various conditions as from car to storage pile, from storage pile to truck, from storage pile to cars, and from lower to higher levels of large storage piles.

The general sales office of the Vulcan Soot Cleaner Sales Company, 230 South La Salle Street, Chicago, Illinois, has been transferred to Du Bois, Pennsylvania, with Mr. G. L. Simonds in charge. This is only a change in location to bring the sales, factory and engineers in immediate touch, with the idea of giving better service to all; the personnel to remain as before.

The Lyons Atlas Company, Indianapolis, Indiana, has recently issued bulletins Nos. 225 and 250. The first is devoted to horizontal four-cycle heavy oil engines in two sizes, 20 and 30 horse power. These engines burn crude and fuel oils, kerosene and intermediate distillates. The second bulletin is devoted to vertical four-cycle heavy oil engines.

The Armstrong Cork & Insulation Company of Pittsburgh, Pennsylvania, has recently issued a folder entitled "Satisfaction or——." It deals with the necessity of supplying drinking water in industrial plants and shows the modern way of providing a refrigerating plant from which the water is piped throughout the factory.

The Revolvator Company, Jersey City, N. J., has recently published Bulletin No. 44, entitled "The Revolvator in the Textile Industry. This booklet illustrates and describes the use of a portable elevator or tiering machine for piling cases, bales, barrels and the like in the storerooms of textile mills and allied industrial plants.

The Bailey Meter Company, Boston, Massachusetts, has just issued Bulletin No. 41, fully describing the Bailey boiler meter, showing how it is installed and the type of records that it gives. The illustrations and the charts are printed in colors, thus making them very easily inspected and read. Much information of value to engineers is contained in the text matter, and the closing page gives a partial list of users of the meter.

The Wheeler Condenser & Engineering Company, Carteret, N. J., announce that the fourth edition of their handbook, entitled "Steam Tables for Condenser Work," is now off the press. One reason why this handbook has met with success is that the pressures below atmosphere are expressed in inches of mercury referred to a 30-inch barometer. It includes a discussion of the mercury column, the errors in such measurements, constants, etc.

The Fellows Gear Shaper Company, Springfield, Vt., announces the bringing out of the third edition of their booklet, "The Involute Gear." This is a concise treatise on the action of involute gearing, it is free from confusing higher mathematics and is plentifully illustrated with explanatory drawings. This third edition has been considerably revised and enlarged, and in its final chapter carries a number of useful tables of gear tooth dimensions.

"Wheeler-Balcke Cooling Towers" is the name of Bulletin 109-B just published by the Wheeler Condenser & Engineering Company, Carteret, New Jersey. This 28-page bulletin shows Wheeler-Balcke cooling towers of numerous designs in capacities varying from a few thousand gallons per hour to nearly a million gallons per hour. Two pages are also devoted to Wheeler-Barnard forced draft cooling towers.

The De Laval Steam Turbine Company of Trenton, N. J., has recently issued a pamphlet, "Centrifugal Boiler Feed Pumps." The feature of the pump described is that the steam turbine rotor and the pump impellers are mounted upon one shaft with only two bearings and are enclosed within one housing. The combined turbine pump casing is split horizontally, and by lifting the cover all the internal and working parts are exposed.

The first booklet devoted to the Lillie evaporator has just been published by the Wheeler Condenser & Engineering Company, Carteret, N. J. This evaporator is manufactured exclusively by the Wheeler Company under an agreement with the Sugar Apparatus Manufacturing Company, owners of the Lillie patents. The booklet calls attention to the factors which particularly adapt the Lillie evaporator to the concentration of waste waters or liquors in various industries.

The Poole Engineering & Machine Company of Baltimore, Maryland, has issued under date of May, 1918, a series of 11 folders, showing applications of their turbo gear for the various types of drives. In detail these folders are: 200 Cylindrical Pump Drive; 201 Ammonia Compressor Drive; 202 Line Shaft Drive; 204 Stoker Drive; 206 Turbine Line Shaft Drive; 208 Air Compressor Drive; 209 Fan Drive; 210 Belt Conveyor Drive; 211 Cement Mill Drive; 212 Rubber Mill Drive; 213 General Information.

Mr. William L. Albro served his apprenticeship as machinist and after working two years at the trade entered the automobile engineering school of the H. H. Franklin Manufacturing Co., Syracuse, New York. When his course was completed he became a traveling engineer for that firm and began the study of the Taylor system of management. Later he was transferred to the production department of the Franklin Co. to install a system to prevent excessive idleness, as described in his article. Still later he became the head of the employment department of that firm. In March he accepted a position with the Independence Bureau, Philadelphia.

The Ingersoll Rand Company, New York City, has recently issued a number of new catalogs and bulletins as follows:

Form 4039. An 8-page bulletin on the Leyner shank and pit punch for punching out holes in bits and shanks of hollow drill steel.

Form 901. A 4-page flyer showing the complete line of Little David pneumatic tools. Tables of sizes and capacities are given and illustrations show all the tools and their applications.

Form 9028. An 18-page catalog illustrating and describing equipment for sugar factory and refinery service. A separate Spanish edition of this catalog is available for those who desire it.

Form 9010. A 4-page catalog on the Sergeant ticket cancelling box.

Form 901-1. A single page flyer on the Little David caulking machine.

Form 888. A 4-page flyer on Little David evaporator tube cleaning and other labor saving pneumatic tools.

Form 876. A single page flyer on Ingersoll-Rand barometric condensing plants.

Form 883A. A single page flyer on Class "FP" steam engines, horizontal center-crank type with piston valves.

Form 3015-1. A 4-page bulletin on ER portable mine car air compressors.

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger division of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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MECHANICAL ENGINEERING	" 75	MINING AND METALLURGY	" 84
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INDUSTRIAL MANAGEMENT

EDUCATION

Colliery Deputies

The Status and Training of Colliery Deputies (86403). J. W. McTrusty. Read before Natl Assn Col Mgrs. 6000 w. Ir & Cl Trds Rev—March 8, 1918. The position in the industry that deputies should occupy, and their training.

Colliery Managers

Discussion of Mr. G. L. Kerr's Paper on "The Higher Education of Colliery Managers (86318 N). 17 pp. Instn Min Engrs, Trans—April, 1918.

Educational Reform

La Réforme De L'Éducation Nationala (86458 C + D). G. Hersent. 11,700 w. Bul Soc D'Encouragement Pour L'Industrie—Jan.-Feb., 1918. Suggestions for improving the system and methods of education in France.

Engineering

Engineering: A Liberal Education (86289 A). Philip B. McDonald. 2500 w. Univ Col Jl Eng—April, 1918. Value of an education in applied science.

Factory Schools

Training Schools in Factories (85938). Allen Sinsheimer. 2500 w. Auto Ind—April 25, 1918. Plans for increasing the number of skilled workers.

Foremen

Creating a Class of Super-Foremen (86406). J. V. Hunter. [illegible] w. Am Mach—May 23, 1918. Ideas in regard to the training of foremen.

Industrial Training

Industrial Training for the War Maimed in Great Britain (86147). I. William Chubb. Ills. [illegible] w. Am Mach—May 9, 1918. Work to enable maimed men to support themselves.

Laboratory

L'Institut Électrotechnique de l'Université de Toulouse (86497 B). C. Camichel and D. Eydoux. Ills. 3500 w. Génie Civil—Apr. 27, 1918. Mechanical engineering laboratories of the University of Toulouse. Equipment, etc.

Il Laboratorio Sperimentale Di Milano (86462 B). A. Danusso. Ills. 5800 w. L'Industria—Mar. 31, 1918. Material testing laboratory at the Milan Technical Institute. Equipment, facilities and methods.

Mechanics

A Curious Misnomer in Mechanics (86284 A). Robert Fletcher. 1500 w. Eng-Ed—April, 1918. Explains misuse of mechanical terms.

Natural Science

The Teaching of Natural Science (86219 A). 4000 w. Engr—April [illegible], 1918. Report of Committee appointed to inquire into the position of natural science in Great Britain.

Naval Training

Engineering Study Directory for Naval Officers Under Training (86259 A). R. R. Smith. [illegible] Inst, Pro—April, 1918. Schedule.

Packard School

Packard Gives Women Complete Mechanical Training ([illegible]). Ills. [illegible] w. Auto Ind—May [illegible], 1918. Thoroughly equipped school accomodating 240 pupils at a time.

Railway Question

The Business Press and the Railway Question (86056). Samuel O. Dunn. [illegible] w. [illegible]—May [illegible], 1918. From an address before the Cleveland Adver[illegible].

Useful Facts

How to Select Those Facts That Are of Greatest Utility (85932). Halbert P. Gillette. 2000 w. Eng & Con—April 24, 1918. Generalizations helpful in determining the usefulness of facts and how to retain them.

FINANCE AND COSTS

Accountants

A Plea for the Cost Accountant (86571 A). George W. Hamilton. 1000 w. Ind Man—June, 1918. Responsibilities of the cost accountant and his recognition.

Accounting

A Foundry Cost and Accounting System (86188 A). William W. Bird. (Abstract.) 1800 w. A S M E, Jl—May, 1918. Otulines a system developed as a result of experiments at Worcester Polytechnic Institute.

Cost Accounting at Coal Mines (86227). J. B. Dilworth. 1800 w. Cl Age—May 11, 1918. Value of cost systems.

Fundamentals of Accounting for Industrial Waste (86419 A). F. J. Knoeppel. 3000 w. Jl Actcy—May, 1918. Industrial accounting; true cost and standard cost.

Standard Accounting Through Price Control (86420 A). Charles Reitell. [illegible] w. Jl Actcy—May, 1918. Needed adjustments in accounting practices. A plea for standardization.

Costs

The Checking of Maintenance Costs ([illegible] A). [illegible]. [illegible] w. Engr—April [illegible], 1918. Outlines a system, explaining its advantages.

Depreciation

The Actuary Theory of Depreciation of Physical Property Values (86060). E. J. Kates. 1500 w. Ry Age—May 3, 1918. Explains theory based upon principles used by the actuary in computing insurance risks.

Inventory

The Value of a Perpetual Inventory (86061). E. C. Constans. 1600 w. Telephony—May 4, 1918. Explains advantages and what it shows.

Public Utilities

The Credit of Public Utilities (86065). Herbert A. Wagner. 3000 w. Elec Wld—May 4, 1918. Commission regulation with limited rate of return should be counterbalanced by elimination of risk.

Railroad Wage

Report of the Railroad Wage Commission (86324). 8 pp. Ry Age—May 17, 1918. Increases amounting to $288,000,000 to be added to increases of $306,000,000 made by railroads. Abstract.

Rates

Commodity Prices and Public Utility Rates (86336). William J. Hagenah. Excerpts from paper before Wis. Gas & Elec. Assn. at Milwaukee. 2000 w. Elec Wld—May 18, 1918. Indications that the decline in prices will be very slow after the war.

Trade

Development of Foreign Trade in Manufactured Products (86085). E. M. Herr. 1700 w. Elec Rev, Chi—May 4, 1918. Address before Manufacturers. Must prepare now for competition.

Commercial Relations of Allies with Russia (86280 A). Sterling H. Bunnell. 2000 w. Iron Age—May 16, 1918. Problems of the American manufacturer in the light of the German invasion.

Export-Trade Problems (86150). Robert S. Alter. From an address at Natl. Foreign Trade Con. in Cincinnati. 4000 w. Am Mach—May 9, 1918. Need of securing foreign trade.

How Machine-Tool Builders Can Coöperate in Foreign Trade (86278). Ludwig W. Schmidt. 2500 w. Am Mach—May 16, 1918. Interesting possibilities.

The Meaning and Methods of German Competition (86218 A). E. T. Good. 2500 w. Engr—April 19, 1918. Discussion of German methods, and steps necessary to compete with them.

Trade Acceptances

Trade Acceptances (86537). George S. Cole. 4000 w. Auto Ind—May 23, 1918. Trade-acceptance system contrasted with open-account methods.

The Trade Acceptance in the Supply Field (86323). 2500 w. Ry Age—May 17, 1918. Discussion of the use of trade acceptance in sales to railway supply companies, and in sales to railways.

War Wages

See same heading under Management.

MANAGEMENT

Engineering Appliances

The Overseas Distribution of Engineering Appliances (86430 N). Leonard Andrews. 10 pp. Instn E E—April 18, 1918. Effect of supply and demand upon competition; production, coordination, and distribution. Refers to the British Empire.

Factory Location

Hunting for a Factory Location (86563 A). L. W. Schmidt. 5000 w. Ind Man—June, 1918. Five tests to apply in selecting an industrial site.

Labor

Basis for Selection of Employees (86574 A). N. D. Hubbell. 2000 w. Ind Man—June, 1918. Outlines the principal points in the employment problem.

Labor Shortage

How the Railway Labor Shortage Can Be Overcome (86045). 2500 w. Eng News-Rec—May 2, 1918. Need for better treatment of men, wider use of machines and careful planning of work.

Labor Turnover

The Problem of Labor Turnover (86275). M. C. Hobart. 2500 w. Am Mach—May 16, 1918. Statement of conditions and expense of labor turnover.

Munitions

Efficiency in Munitions Production (86477). 3100 w. Times Engng Supp—Apr. 26, 1918. Reserves of men and output of factories. British Government now demanding maximum efficiency.

Order Records

Combined Schedule - Record - Route Sheet (86572 A). E. T. Spidy. 300 w. Ind Man—June, 1918. Diagrams and explanation of their use.

Payroll Records

How Five Firms Keep Payroll Records Up to Date (86575 A). Articles by George B. Merriam, John C. Bower, Holland L. Church, M. C. Hobart, and William Lamkie. 5000 w. Ind Man—June, 1918. Use of employment records.

Power

Master Power Production—VI. (86568 A). Walter N. Polakov. 5000 w. Ind Man—June, 1918. Thorough training of workers precedes successful operation.

Time Studies

Preventing Man and Machine Idleness (86562 A). William L. Albro. 3000 w. Ind Man—June, 1918. A system of checking up useful time and idle time of both men and machines as applied in a large automobile factory.

Time Studies for Rate Setting on Machine Tools (86559 A). Dwight V. Merrick. 5000 w. Ind Man—June, 1918. Serial, 1st part. Articles explaining the object and methods of time studies.

Trade

The Promulgation of Improvements in Design and Manufacture (86129 A). 1800 w. Elec Rev—Apr. 12, 1918. The value of publicity campaigns in promoting trade and of individualistic competition to improve quality of products.

War Wages

War Wages in England and France (86215 A). 1500 w. Engr—Apr. 19, 1918. Bonuses for time-workers and advances in cost-of-living.

War Work

Planning for War Work (85975 A). Alfred Spangenberg. 1600 w. Machy—May, 1918. Making estimates for manufacturing for the government and equipping a factory for war work.

Wastes

La Récuperation et L'Utilisation des Déchets de L'Industrie Sidérurgique (86474 B). P. Razous. 3800 w. Génie Civil—Apr. 6, 1918. Serial, 1st part. Recovery and utilization of metal wastes.

Women Workers

American Women in War Industry (86567 A). C. E. Knoeppel. 4500 w. Ind Man—June, 1918. Serial, 1st part. How are they to be selected and trained, and the problems of war wages, hours, and working conditions.

Women in Filling Factories (86478). 1000 w. Times Engng Sup—Apr. 26, 1918. Advantages of employing women to release men for war work.

REGULATION

Business

Chicago Meeting of the Chamber of Commerce of the United States (86148). 2500 w. Am Mach—May 9, 1918. Extracts from speeches made by R. Goodwyn Rhett and Edward A. Filene.

Commerce

Post-War Commercial and Industrial Policy (86373 A). 2500 w. Engng—May 3, 1918. Editorial review of the recently issued committee report on methods of safeguarding British industry.

Food Administration

Food for the War (86395). H. C. Hoover. 6000 w. Min & Sci Pr—May 18, 1918. Speech before Pittsburgh Press Club. The aims and the necessity for cooperation.

Food Wastes

Food Wastes—Some Causes and Remedies (86311 B). Lucius P. Brown. Ills. 25 pp. Fkn Inst, Jl—May, 1918. Wastes in harvesting, in manufacture, in transit and distribution, and in the kitchen.

Industrial Problems

Presidential Address Before the Iron and Steel Institute (86374 A). Eugène Schneider. 5500 w. Engng—May 3, 1918. Industrial problems to be met after the war, particularly in the metallurgical field.

Kitchens

National Kitchens (86482). 2000 w. Times Engng Supp—Apr. 26, 1918. Choice of equipment. Apparatus used and systems described.

Labor

Development of Community Interest (86072). Charles F. Willis. 2000 w. Eng & Min Jl—May 4, 1918. Value as a phase of welfare work for western metal mines.

Post-War Prospects (86246 A). H. Kay. 1000 w. Mech Wld—Apr. 26, 1918. The labor question and the problems to be met.

Man Power

Man Power (86410 D). J. Parke Channing. 3300 w. A I M E, Bul—May, 1918. Labor problems in the United States.

Organization

"The Whitley Scheme": A Step Toward Democratising Industrial Relations (86296 N). C. V. Corliss. 5000 w. Can Min Inst, Bul—May, 1918. Explains the scheme and some of its ideals.

Power

See same heading under Management.

Standardization

La Standardisation Technique Et Industrielle (86457 C + D). P. Toulon. 2200 w. Bul Soc D'Encouragement Pour L'Industrie—Jan.-Feb., 1918. Technical and industrial standardization. Review of advantages of international agreement on the subject.

Trade

Trade Parliaments and Their Work (86362 A). Ernest J. P. Benn. 1000 w. Elec'n—Apr. 26, 1918. Serial, 1st part. Work waiting to be done by Trade Parliaments.

WELFARE AND SAFETY

Benefit Association

The Employees' Benefit Association (86564 A). W. L. Chandler. 4000 w. Ind Man—June, 1918. Fifth article of a series. Gives charts for various combinations of dues paid.

Cranes

Safety Standards for Cranes (86268 A). Ills. 3500 w. Sfty Eng—April, 1918. Code and rules of the Industrial Board of the Penn. Dept. of Labor and Industry.

Eye Protection

Eye Protection in the Machine Industry (85979 A). Ills. 2500 w. Machy—May, 1918. Causes of injuries to the eye and methods of prevention.

Health Supervision

Development of the Health Department of Thomas A. Edison Interests (86569 A). Mark M. Jones. 3000 w. Ind Man—June, 1918. How the department was developed and the results.

A Ministry of Health (86454 A). W. M. Bayliss. 1700 w. Nature—Apr. 18, 1918. Proposal to create a ministry of Health for England. Outline of its functions and scope.

Housing

See same heading under CIVIL ENGINEERING, *Construction.*

Injuries

Strains and Overexertion (86405). Chesla C. Sherlock. 2200 w. Am Mach—May 23, 1918. Résumé of court decisions in regard to injuries caused by strains.

Mine Cafeteria

See same heading under MINING AND METALLURGY, *Mine Operation.*

National Welfare

The Application of Organized Knowledge to National Welfare (85998 A). P. G. Nutting. 4500 w. Sci M—May, 1918. Outline of some of the more general problems involved.

Safety

See same heading under MARINE AND NAVAL ENGINEERING.

Safety Work

The Importance of Organized Safety Work (86171). H. W. Belnap. 3000 w. Ry Age—May 10, 1918. Plea for general application of methods of reaching the employee in accident prevention campaigns.

Sanitation

Plant Sanitary Equipment (86267 A). W. N. Fitch. 2500 w. Sfty Eng—April, 1918. Sanitary requirements.

Slipping

The Menace of Slipping (86266 A). Ills. 1200 w. Sfty Eng—April, 1918. Casualties due to slipping, etc.

MISCELLANY

South Africa

Industrial Development in South Africa (86128 N). J. H. Dobson. 16 pp. So Af Instn Elec Engrs, Trans—Feb., 1918. The industrial awakening.

War Obligations

Some Things We Can Do to Help Win the War (86255). Eugene H. Angert. 16 pp. St L Ry Cb, Pro—April 12, 1918. Patriotic address.

MECHANICAL ENGINEERING

AERONAUTICS

Aeroplanes

Calculation of Stresses in Aeroplanes (86341). S. E. Slocum. 2000 w. A A Wkly—May 20, 1918. Serial, 1st part. Aims to explain as simply as possible the four main items involved in the design of aeroplanes.

German Aeroplane Design (86484). 1300 w. Times Engng Supp—April 26, 1918. Construction and details of the Fokker triplane and a bombing plane.

Stability of Aeroplanes (86368 A). H. A. Webb. 800 w. Engng—May 3, 1918. Aims to give a simple proof of the fundamental equations of stability.

Starting, Landing and Piloting Large Aeroplanes (86076 A). Silvio Resnati. Ills. 1000 w. Flying—May, 1918. Considers a 5,000 hp. air-cruiser a near possibility. Its manipulation discussed.

The Friedrichshafen Bombing Aeroplane (86248 A). 800 w. Engr—April 26, 1918. Serial, 1st part. Information concerning the design and construction from a report by the Aircraft Production Department of the Ministry of Munitions.

The Berckmans Speed Scout (85,-983). George F. McLaughlin. Ills. 800 w. A A Wkly—April 29, 1918. Detailed description. Quick climbing ability one of the inherent features of its design.

The Use of Jigs, Fixtures, Gauges, and Tools in Aeroplane Manufacture (86075). R. Borlase Matthews. Ills. 3500 w. A A Wkly—May 6, 1918. Serial, 1st part. Substance of a lecture delivered at Roy. Soc. of Arts, London.

Woodworking Machinery in Aeroplane Construction (86339). Ills. 3000 w. A A Wkly—May 20, 1918. Details of the construction of the machine.

Aircraft

Aircraft Board Reorganized by President (86534). 2000 w. Auto Ind—May 23, 1918. The President's order reorganizing aircraft activities.

Airplane Cylinder

Manufacturing the Curtiss Airplane Cylinder (86404). G. D. Ranger. Ills. 1200 w. Am Mach—May 23, 1918. Covers operations in their sequence.

Biplanes

The Albatross Fighting Biplane (86,-536). Ills. 1400 w. Auto Ind—May 23, 1918. Serial, 1st part. Detailed description of one of the best known German fighting machines.

The Friedrichshafen 450 H.P. Gotha II Fighting and Bombing Biplane (86,-340). Ills. 1000 w. A A Wkly—May 20, 1918. Detailed description.

Maps

Army Topographical Division Coordinates Work of Map Makers in Air and on Ground (86440). Robert K. Tomlin, Jr. Ills. 2500 w. Eng News-Rec—May 23, 1918. Existing French maps used as a basis for new work. Making relief maps.

Nomenclature

Nomenclature for Aeronautics (86,-074). 3500 w. A A Wkly—May 6, 1918. Prepared by the National Advisory Committee for aeronautics.

Triplane

The Sopwith Triplane (86177). Ills. 1000 w. Auto Ind—May 9, 1918. New British scout. Has low specific wing load and excellent climbing abilities.

AUTOMOBILES

Accessories

New Ideas in Automobile Accessories (85950 A). Ills. 1500 w. Aust Min Stand—March 21, 1918. Details of many appliances found useful.

Contact Breaker

A New Bosch Magneto Contact Breaker (86032 A). Ills. 3000 w. Autocar—April 13, 1918. Said to result in a better spark, longer life of contacts, and other advantages.

Electric Vehicles

The Electric Commercial Vehicle (86135 A). 3500 w. Engr—April 12, 1918. Causes of failure in the past, drawbacks, uses for which they are suited, advantages, etc.

Engine Practice

Fundamentals of Engine Practice Reopened for Discussion (86538). J. E. Schipper. Ills. 1500 w. Auto Ind—May 23, 1918. Changes in valve location, manifold layouts and possibilities of overhead camshaft types.

Engines

Continental Model 9N Engine (86,-063). Ills. 1000 w. Auto Ind—May 2, 1918. Succeeds model 7N. Has heavier crankshaft which is very carefully balanced.

Engine Valves

Improvement in Engine Valves (86,-176). J. Edward Schipper. Ills. 1000 w. Auto Ind—May 9, 1918. New valve materials adopted partly as a result of scarcity of tungsten.

Glass Fronts

Design of Automobile Glass Fronts (86062). Karl Feilcke. Ills. 1600 w. Auto Ind—May 2, 1918. Serial, 1st part. Proper design of windshields; [illegible] and how best attained; difficulties and how eliminated.

Headlights

Report on Road Test of Headlighting Conditions Made Under the Auspices of the Committee on Automobile Headlighting Specifications of the Illuminating Engineering Society and the Lighting Division of the Standards Committee of the Society of Automotive Engineers (86428 N). 25 pp. Ill Eng Soc—April 11, 1918. Report of the 1916-17 committee on automobile head lamps.

Performance Tests

Performance Tests by Accelerometer (85937). H. C. Skinner. 1000 w. Auto Ind—April 25, 1918. Means of determining traction resistance; calculation of engine horsepower.

Remy System

Remy System Combines Governor with Generator (86064). Ills. 900 w. Auto Ind—May 2, 1918. Adapted particularly to tractor use.

Tractors

Manufacture of Worm Gear and Assembly Methods Factors in Fordson Tractor Success (85936). Ills. 2000 w. Auto Ind—April 25, 1918. Time saving process.

Resistance to Rolling of Tractor Wheels in Soft Ground (86349). Amos F. Moyer. 3500 w. Auto Ind—May 16, 1918. Preliminary report of research to determine relation between rolling resistance, specific load, wheel diameter, speed and other factors.

Trucking

Growth of Return Loads Bureaus Requires a Government Director (86,-073 A). Map. 3000 w. Com Vhle—May 1, 1918. The need and requirements.

HEATING AND COOLING

Air Conditions

Report on Air Conditions at the Paris Garter Factory (86423). Ills. 2200 w. Ht & Vtg Mag—May, 1918. Serial, 1st part. Details of a Chicago building, the ventilating system tests, etc.

Air Washer

A High-Speed Air and Gas Washer (86194 A). John L. Alden. (Abstract.) Ills. 2000 w. A S M E Jl—May, 1918. A new type offering advantages over existing types.

Ammonia

Conservation of Ammonia ([illegible]). A. G. Solomon. Ills. 2000 w. Pwr Pt Eng—May 1, 1918. Serial, 1st part. Ideas on the prevention of loss.

Central Heating

Central Station Heating in Detroit (86091). J. H. Walker. Ills. 2500 w. Power—May 7, 1918. Features of the live steam heating plants and system of the Detroit Edison Co.

Drying

Address on Dehydration (86512 D). H. C. Gore, with discussion. 3000 w. Am Soc Ht & Vtg Engrs, Jl—April, 1918. Important points in conserving the food supply by drying.

Food Dryers and the Use of School Houses for Drying (86449 D). W. L. Fleischer. Ills. 15 pp. Am Soc Ht & Vtg Engrs, Jl—April, 1918. Information concerning methods and food values.

Evaporation

Some Problems in Evaporation and Drying (86307 A). P. B. Sadtler and F. M. de Beers. 2000 w. Met & Chem Eng—May 15, 1918. Abstract of paper before Am Inst of Chem. Engrs. Design of evaporators.

Fuel

Address on Fuel Conservation (86,514 D). George W. Martin, with discussion. Ills. 4000 w. Am Soc Ht & Vtg Engrs, Jl—April, 1918. The use of forced draft with low grade fuels. Change from isolated plant to central station service.

Address on Fuel Conservation (86,513 D). L. P. Breckenridge, with discussion. 2500 w. Am Soc Ht & Vtg Engrs, Jl—April, 1918. Production, distribution, use, and economy.

Furnace Heating

Furnace Heating Engineers' Opportunity (86511 D). D. Rait Richardson. 2200 w. Am Soc Ht & Vtg Engrs, Jl—April, 1918. The commercial side of warm air furnace business.

The Engineering of Warm-Air Furnace Heating (86510 D). M. William Ehrlich, with discussion. Ills. 20 pp. Am Soc Ht & Vtg Engrs, Jl—April, 1918. Rules and recommendations for installing and operating.

Heating

Economy in Heating (86509 D). Konrad Meier. 10 pp. Am Soc Ht & Vtg Engrs, Jl—April 1918. The requirements, production and application of heat.

Heating Boilers

Unstable Water Lines in Heating Boilers (85986). Charles L. Hubbard. Ills. 3000 w. Pwr Pt Eng—May 1, 1918. Causes and remedies.

Ice

Preventing Red Core (86126 A). Louis Block. Ills. 1400 w. Ice & Refrig—May, 1918. Causes and prevention.

Laundries

Machine Laundries (86483). 1000 w. Times Engn Supp—April 26, 1918. Machinery and equipment for washing, drying, etc., in hospitals and munition works.

Refrigeration

Carbonic Acid Refrigerating Machines (86127 A). J. C. Goosmann. 2000 w. Ice & Refrig—May, 1918. Some of the conditions that have delayed their adoption.

Conservation of Ammonia and Coal (86125 A). Edward N. Friedmann and Van R. H. Greene. 2000 w. Ice & Refrig—May, 1918. Losses and improvements.

Vapor Heating

Modern Practice in Vapor Heating (86422). Harold L. Alt. Ills. 2300 w. Ht & Vtg Mag—May, 1918. Serial, 1st part. Methods and devices.

HYDRAULIC MACHINERY

Nozzles

Lo Scarico Sincrono (86463 B). M. Lo-Presti. Ills. 3500 w. L'Industria—Mar. 31, 1918. Serial, 1st part. Nozzle mechanism for regulating flow to water turbine. Calculations for design.

MACHINE ELEMENTS AND DESIGN

Ball Races

Ball Races in Machine Tools (86037 A). Joseph Horner. Ills. 1500 w. Mech Wld—Apr. 19, 1918. Serial, 1st part. Improvements made necessary when employing them for heavy machine tools.

Bearings

A Self-Adjusting Spring Thrust Bearing (86195 A). H. G. Reist. (Abstract.) Ills. 1200 w. A S M E, Jl—May, 1918. A flexible bearing surface pressed against the runner by springs.

The Manufacture of Ball Bearings (86134 A). Ills. 3000 w. Engr—Apr. 12, 1918. Serial, 1st part. Works of the Skefko Ball Bearing Co., Ltd., at Luton, Bedfordshire, Eng.

Cams

Practical Cam Design (86276). L. G. Johns. Ills. 1200 w. Am Mach—May 16, 1918. Recommendations as to the best form of cam surfaces and the best operating angles for those surfaces.

Analysis of Valve Cams (86035 A). W. E. Wright. Ills. 1800 w. Mech Wld—Apr. 12, 1918. Outlines methods of procedure.

Gear Blanks

Heat Treatment of Gear Blanks (85939). C. R. Poole. 2500 w. Auto Ind—Apr. 25, 1918. Outlining the advantages of thoroughly annealed blanks.

Gears

Standardization of Gearing (85940). B. F. Waterman. From a paper read before the Am. Gear Mfrs.' Assn. 3000 w. Auto Ind—Apr. 25, 1918. Preparing to standardize practice.

The Design and Progress of the Floating-Frame Reduction Gear (86408 B). John H. Macalpine, with discussion. Ills. 71 pp. Engrs' Soc W Penn, Pro—Feb., 1918. Considers only toothed gearing.

Thickness of Involute Gear Teeth on Addendum Circle (85977 A). Reginald Trautschold. 2500 w. Machy—May, 1918. Method of generating silent gears.

Gear Teeth

The Shape of Gear Teeth (86448 A). I. H. Wright. Ills. 15 pp. Keighley Assn. Engrs—1916-17. Qualities of gear teeth which can be relied upon, suggesting means of avoiding interference.

Mechanisms

Ingenious Mechanical Movements (85974 A). Franklin D. Jones. Ills. 6000 w. Machy—May, 1918. Serial, 1st part. Mechanisms for transmitting, modifying and controlling motion.

Narrow Guides

Applications of the Narrow Guide (86243 A). Fred Horner. Ills. 800 w. Mech Wld—Apr. 26, 1918. Serial, 1st part. Applications of the narrow guiding principle on various types of machine tools.

Valves

Hand-Regulated Valves (86040 A). Ills. 2000 w. Mech Wld—Apr. 19, 1918. Serial, 1st part. Essentials of a good hand-regulated valve, and care needed in designing. Uses and troubles.

MACHINE WORKS AND FOUNDRIES

Aluminum

On the Annealing of Aluminium (86213 A). Robert J. Anderson. Ills. 700 w. Engng—Apr. 12, 1918. Read before the Inst. of Metals. Details of the work.

Axles

Hollow Steel Axles and Safety First (86015 A). Julian Pollak. Ills. 1000 w. Iron Age—May 2, 1918. Relatively stronger axles insured by more accurate heat treatment.

Bronze Tablets

Molding and Casting Ornamental Bronze Tablets (86011). Charles Vickers. Ills. 1200 w. Fndry—May, 1918. Difficulties are pointed out and mixtures considered.

Castings

Cooling Rate Affects Steel Casting Design (86007). J. G. Fletcher. 4500 w. Fndry—May, 1918. Serial, 1st part. Study of the contraction of steel.

Estimating the Weights of Castings Rapidly (86009). Warner Hathaway. Ills. 800 w. Fndry—May, 1918. Several easy methods of ascertaining the weights from blue prints.

Cast Iron

Growth of Gray Cast Iron by Repeated Heating (86013). J. E. Hurst. Ills. 2500 w. Fndry—May, 1918. Investigation, with particular reference to cylinders and pistons for internal combustion engines.

Drop Stamp

Heavy Friction Drop Stamp (86221 A). Ills. 800 w. Engr—Apr. 19, 1918. Details of a 9½ ton friction drop stamp and its operation.

Foundries

Lift Trucks Cut Transportation Costs (86439 A). Ills. 1500 w. Iron Age—May 23, 1918. Raw materials, ladles, and finished product handled by electric and hand types at the Modern Foundry Co.'s plant.

Saginaw Malleable Iron Co.'s Plant (86145 A). Ills. 2500 w. Iron Age—May 9, 1918. Foundry of modern type for large production.

Foundry Methods

Handling Government Work in a Steel Foundry (86006). H. Cole Estep. Ills. 3000 w. Fndry—May, 1918. Many inspections and tests are made and every casting is stamped with the heat number.

Foundry Practice

Foundry Practice: Mechanical Tests for Cast Iron (86508 A). F. J. Cook. Ills. 29 pp. Keighley Assn Engrs—1916-17. Considers tests usually called for by engineers' specifications, and those adopted as a guide in the foundry.

Furnaces

Wincott Furnaces (86214 A). Ills. and Plates. 1500 w. Engng—April 19, 1918. Details of gas-fired steel melting furnaces, forge furnaces, shell heating furnace, and furnaces for annealing large steel castings and shells.

Grinding

Cylindrical Grinding (86038 A). William D. Adamson. Read before Jun. Instn. of Engrs. 1500 w. Mech Wld—April 19, 1918. Serial, 1st part. Details of the work.

Drill Grinding (85981 A). Edward K. Hammond. Ills. 4000 w. Machy—May, 1918. Requirements and methods.

Handling Devices

British Shell-Shop Handling Devices—III (86566 A). George Frederick Zimmer. Ills. 4500 w. Ind Man—June, 1918. Final instalment of a series. Transporters and conveyors used; best methods of handling, etc.

Heat Control

The Importance of Heat Control in Certain Engineering Operations (86036 A). O. Bertoya, Jr. 1000 w. Mech Wld—April 12, 1918. Satisfactory methods of tempering, hardening, annealing, etc.

Hobs

Hobs and Hobbing (86350). F. G. Hoffman and John Edgar. 3000 w. Auto Ind—May 16, 1918. Hobbing process especially suitable for quantity production.

Machine Forging

Machine Forging (86384 A). D. M. Caird. Ills. Abstract of a paper before the Manchester Assn. of Engrs. 4000 w. Ir & Cl Trds Rev—March 29, 1918. Deals with rivet heading machines, upsetting and forging machines, taper forging rolls, and bulldozers.

Machine Tools

See Time Studies, under INDUSTRIAL MANAGEMENT, *Management*.

Molding

Electric Heating of Molds (86193 A). Harold E. White. (Abstract.) Ills. 1500 w. A S M E, Jl—May, 1918. Describes a novel method of applying heat to the molds.

Molding a Superheater Locomotive Cylinder (86008). R. H. Palmer. Ills. 1500 w. Fndry—May, 1918. Intricate casting involving the setting of a large number of cores.

Moulding Retorts in Loam (86245 A). B. Shaw. Ills. 1200 w. Mech Wld—April 26, 1918. Serial, 1st part. Methods successfully used.

Molding Machines

Molding Machines Facilitate the Production of Castings for Tractors (86014). Ills. 1200 w. Fndry—May, 1918. Methods in a Cleveland, O., plant.

Munition Factories

An Extemporised Munition Factory (86136 A). Ills. 1500 w. Engr—April 12, 1918. Serial, 1st part. Detailed description of an English factory and its equipment.

Munitions

Operations in the Manufacture of High-Explosive Shells (86049). Ills. 1500 w. Am Mach—May 2, 1918. Information from successful firms.

Patternmaking

Patternmaking Allowances (86039 A). James Edgar. 1300 w. Mech Wld—April 19, 1918. Importance of studying machining, the contraction of metals, and the annealing of steel in the pattern shop.

Plating

A Model Modern Job Plating Shop (86447). Ills. 2500 w. Brs Wld—May, 1918. Account of one of the leading polishing and plating shops in New York City.

Production of Verde Antique Finishes (86446). Emil Haas. 1200 w. Brs Wld—May, 1918. Directions for working practice.

Screwing Tackle

Screwing Tackle and Gauge Departments at Openshaw Works (86402 A). Ills. 2000 w. Ir & Cl Trds Rev—March 8, 1918. Work of the gauge department and details of Whitworth measuring machine, etc.

Screw Machine

Operating the Gridley Multiple-Spindle Screw Machine (85982 A). Douglas T. Hamilton. Ills. 3500 w. Machy—May, 1918. Instructions for tooling, setting up, and operating.

Shop Practice

American Practice in Work Handling (86242 B). Douglas T. Hamilton. Ills. 3500 w. Auto Engr—April, 1918. Examples of methods in various well-known plants.

Machining the Stitch-Making Mechanism for Hosiery Machines (86149). Robert Mawson. Ills. 1500 w. Am Mach—May 9, 1918. Operations on interchangeable parts.

Salvaging

Salvaging Tools in War Time (84973 A). Edward K. Hammond. Ills. 6500 w. Machy—May, 1918. Methods of procedure in salvaging commonly used types of metal-cutting tools, and saving possible.

Waste-Heat Boilers

The Waste-Heat Boiler for Malleable Furnaces (86012). Arthur D. Pratt. Diagrams. 5000 w. Fndry—May, 1918. Theory of this unit and advantages of its application in malleable cast iron foundries.

Welding

Some General Applications of Electric Welding Process (86099). Ills. 1200 w. Mar Eng, Can—April, 1918. Shows its widening field of usefulness.

Thermit Welding (86254 A). R. L. Browne, with discussion. Ills. 58 pp. N Y Rd Cb, Pro—Apr. 19, 1918. History and description of the process, its applications, etc.

The Welding of Carbon Tools (86445 A). B. Kopferschmidt. Ills. 1800 w. Weld Engr—May, 1918. Methods used in successfully reclaiming broken tools.

Modern Methods of Welding (86452 A). Ills. 1400 w. Nature—Apr. 11, 1918. Use of water-gas for welding large pipe. Electric arc welding also described.

Westinghouse Works

South Philadelphia Works of the Westinghouse Company (86570 A). Ills. 3000 w. Ind Man—June, 1918. Features of a new plant to build power-plant machinery, at Essington, Pa.

Woodworking

Value of Flywheels in Woodworking (86201). David R. Shearer. 1000 w. Elec Wld—May 11, 1918. Have proved especially desirable in plants where individual motor drives are installed.

MATERIALS OF CONSTRUCTION

Alloys

Interesting Things in Metallurgical Chemistry (85980 A). C. W. Starker. Ills. 1800 w. Machy—May, 1918. The eutectic alloy and changes occurring in metals and alloys when cooling.

Notes on Non-Metallic Inclusions in Bronze and Brass (85925 N). G. F. Comstock. Ills. 2500 w. A I Met, Jl—March, 1918. Work on castings of copper, brass, or bronze to determine the characteristic appearance of each kind of inclusion.

Stellite (86306 A). Elwood Haynes. Ills. 1800 w. Met & Chem Eng—May 15, 1918. Report on the physical and chemical properties of alloys of cobalt, chromium, tungsten, and molybdenum.

Brass

Travail Du Laiton A Froid (86472 B). H. Bertin. Ills. 3200 w. Génie Civil—Apr. 6, 1918. A formula for determining dimensions of tools for drawing, rolling and stamping brass.

The Volatility of the Constituents of Brass (85926 N). John Johnston. 3500 w. A I Mt, Jl—March, 1918. Research work on the vapor pressure of metals.

Cotton

La Catonicultura Nella Colonia Eritrea (86460 B). V. Peglion. Ills. 5200 w. L'Industria—Mar. 15, 1918. Cotton raising in one of Italy's colonies in Africa, and the cost of raw cotton to Italian industry.

Les Ressources Cotonnières De Nos Colonies (86459 C + D). P. Bourdarie. 20,000 w. Bul Soc D'Encouragement Pour L'Industrie Nationale—Jan.-Feb., 1918. Cotton available in the French colonies. Value of the product after the war.

Some Applications of Research to the Cotton Industry (86342 A). W. Lawrence Balls, with short discussion. 13 pp. Roy Soc Arts, Jl—May 3, 1918. A study of the cotton crop, with special reference to Egypt.

Lead

L'Emploi De La Pression Plastique Du Plomb (86473 B). M. Lunet. Ills. 2400 w. Génie Civil—Apr. 6, 1918. Use of the plasticity of lead to transmit pressure in certain operations in forming metals.

Refractories

Some Physical Properties of Acid Refractory Materials and Methods for Estimating Them (86391 A). G. E. Foxwell. Ills. 3500 w. Ir & Cl Trds Rev—Apr. 12, 1918. The more important physical properties of firebricks, with methods employed for measurement.

The Problems of Refractories (86481). 2000 w. Times Engng Supp—Apr. 26, 1918. Properties of silica; its different forms; presence of iron; effect of carbon, etc., etc.

Rubber

Defects in Industrial Rubber Goods (86303 A). Frederic Dannerth. 3000 w. Met & Chem Eng—May 15, 1918. Glossary of defects with suggestions as to cause and prevention.

Stellite

Deloro Smelting & Refining Co., Ltd., Deloro, Ont. (86319). Ills. 4500 w. Can Fndman—May, 1918. The home of stellite—a non-ferrous alloy of cobalt and other metals.

Sulphuric Acid

Sulphuric Acid and the War (86453 A). T. E. Thorpe. 1100 w. Nature—Apr. 11, 1918. Uses in war, new sources, etc.

MEASUREMENT

Air-Compressors

Testing an Air-Compressor (86238 A). Walter S. Weeks. Ills. 1500 w. West Eng—May, 1918.

Balancing Machine

The Carwen Dynamic Balancing Machine (85984). G. Douglas Wardrop. Ills. 3000 w. A A Wkly—Apr. 29, 1918. Principle and construction of the machine, with general notes.

Calorimeter

An Aneroid Calorimeter for Specific and Latent Heats (86031 A). Nathan S. Osborne. Ills. 25 pp. U S Bur Stds—Apr. 6, 1918. Designed for measurement of heats of a certain class of materials adapted for use in artificial refrigeration.

Dilution

Heats of Dilution and Their Variations with Temperature (86313 B). Frank R. Pratt. Ills. 33 pp. Fkn Inst, Jl—May, 1918. Research work and apparatus.

Dynamometers

Commercial Dynamometers (86244 A). P. Field Foster. Ills. 1800 w. Mech Wld—Apr. 26, 1918. Serial, 1st part. Describes some of the commercially applicable types.

Equilibrium Diagram

The Iron-Carbon Equilibrium Diagram and Its Practical Usefulness (86212 A). H. C. H. Carpenter. 6500 w. Engng—Apr. 12, 1918. Serial, 1st part. Shows how the diagram has been constructed and illustrates its practical use.

Gauge Testing

Optical Projection Apparatus for Testing Gauges (86223 A). Ills. [illegible] w. Engr—Apr. 26, 1918. Details of projection apparatus and the requirements and use.

Gravity

The Value of 'g' in Engineering and Physical Work (86001 A). Sanford A. Moss. Map. 9 pp. Gen Elec Rev—May, 1918. Effect of variations in the intensity of gravity, with data for corrections.

Guns

Long Range Artillery Calculation (86365 A). George Greenhill. 2000 w. Engng—Apr. 26, 1918. Methods of calculating long range fire.

Machine Stresses

Stresses in Machines When Starting or Stopping (86191 A). F. Hymans. (Abstract.) Ills. 2500 w. A S M E, Jl—May, 1918. Method for their determination, taking account of inertia and elasticity.

"Mass"

The Much Abused Term "Mass" in Engineering Calculations (86241 A). Carl Hering paper discussed by John C. Trautwine, Jr., with reply by Carl Hering. 2500 w. E Cb Phila, Jl—May, 1918.

Measuring Machine

Measuring Templets and Screw Threads With a Microscopic Measuring Machine (85976 A). Franklin D. Jones. Ills. 1500 w. Machy—May, 1918. Construction and adjustment of measuring machine and application for testing accuracy.

Record Chart

An Improved Progress-of-Work Chart (86314 B). F. J. Schlink. 700 w. Fkn Inst. Jl—May, 1918. Describes a simple and compact type of running record chart of interest and value to industrial plants and testing laboratories.

Steel Balls

The Elastic Indentation of Steel Balls Under Pressure (86192 A). C. A. Briggs, W. C. Chapin, and H. G. Heil. (Abstract.) 1500 w. A S M E, Jl—May, 1918. Experiments and results.

Turbine Blading

Stresses in Turbine Blading (86363 A). Gerald Stoney. 2200 w. Engng—Apr. 26, 1918. Methods used in estimating stresses.

Viscosity

Standard Substances for the Calibration of Viscometers (86028 A). Eugene C. Bingham and Richard F. Jackson. Ills. 27 pp. U S Bur Stds—Apr. 6, 1918. Research; measurement of viscosity, etc.

Weighing Scale

Stabilized-Platform Weighing Scale of Novel Design (86140). Frederick J. Schlink. Ills. 26 pp. U S Bur Stds. Tech paper 106—Mar. 12, 1918. Theory and design of a new type of check-stabilized weighing scale, with copy of patent.

POWER AND TRANSMISSION

Belts

Belt Practice (85990). W. F. Schaphorst. 1600 w. Pwr Pt Eng—May 1, 1918. Care of belts; formula for fabric belts.

Canada

Canada's Water Powers and Their Relation to the Fuel Situation (86274). J. B. Challies. Ills. 2500 w Can Min Jl—May 1, 1918. Extracts from a paper before Can. Soc. of C. E. Discussion of present fuel and power situation.

Elevators

Operation and Maintenance of Elevators—Arrangement of Cables (86558). R. H. Whitehead. Ills. 1500 w. Power—May 28, 1918. Different ways of roping up the winding-drum type of elevator machine for overhead and basement installations.

Gear Drives

Efficiency of Gear Drives (86187 A). C. M. Allen and F. W. Roys. Ills. 1800 w. (Abstract.) A S M E, Jl—May, 1918. Theory of apparatus used and method of testing.

Indicators

Transmitting Crosshead Motion to the Indicator (85987). C. E. Anderson. Ills. 1800 w. Pwr Pt Eng—May 1, 1918. Directions for making reducing motion.

Power By-Products

The Power By-Product Problem (86133 A), T. Roland Wollaston. From a paper before the Soc. of Engrs. 1800 w. Colly Gdn—Apr. 12, 1918. Possibilities of gas-recovery system.

A Survey of the Power By-Product Problem (86390 A). T. Roland Wollaston. Abstract of paper before Soc. of Engrs. Ills. 3000 w. Ir & Cl Trds Rev—Apr. 12 1918. Estimates and possibilities.

Tidal Power

Tidal Power (86480). Ills. 3200 w. Times Engng Supp—Apr. 26 1918. Possible methods of utilizing the energy of ocean tides. Theoretical considerations.

Water Powers

The Government and the Water Powers (86230). An interview with Hon. Franklin K. Lane. 1800 w. Power—May 14, 1918. Discusses the administration's water-power bill.

STEAM ENGINEERING

Boilers

Supporting Effect of Boiler Heads (86358). Neil M. MacDonald. 1500 w. Power—May 21, 1918. Finding the allowable pressure in a boiler.

Boiler Settings (86557). Charles H. Bromley. Ills. 1600 w. Power—May 28, 1918. One of a number of articles on boiler settings for various stokers under the many different boilers adapted to high-volatile coals.

The Boiler Inspector's Work (85972). M. T. Glenn. 2500 w. Power—Apr. 30, 1918. Describes work, tools used, etc.

Coal Handling

See same heading under Transporting and Conveying.

Condensation

Steam Condensation (86130 A). A. Arnold. 1800 w. Elec Rev—Apr. 12, 1918 Explanation of the process.

Corliss, George Henry

The "One Hundredth Anniversary" of George Henry Corliss (86229). H. F. Mueller. Ills. Power—May 14, 1918. An account of the life and work of the inventor of the Corliss engine.

Engine Design

A Comparative Study in Steam-Engine Design (86287 A). F. S. Bauer. 1200 w. Univ Col Jl Eng—April, 1918. Third installment in a discussion of the effects of design when important operating conditions are varied.

Entropy

Entropy (86257). C. A. Joerger. Diagrams. 1500 w. Pwr Pt Eng—May 15, 1918. What it is and how to use it.

Exhaust Steam

The Economical Employment of Auxiliary Exhaust Steam (86260 A). E. E. Wilson. Diagram. 1700 w. U S Nav Inst, Pro—April, 1918. Method of recovering waste heat, giving outline of plant.

Fuels

Burning Dust-Bearing Coal (86531). L. A. Stenger. 1500 w. Elec Wld—May 25, 1918. Results of tests to determine how this fuel can be burned efficiently.

Les Combustibles Inférieurs (86492 B). L. Renié. Ills. 2800 w. La Nature—Apr. 13, 1918. Furnaces and stokers for burning low-grade fuels and manufacturing wastes.

Experience With Powdered Coal (86338). A. E. MacInnes. Ills. 2000 w. Elec Wld—May 18, 1918. Method of preparing and burning. Results of tests.

The Burning of Pitch and Creosote Mixtures (86217 A). Ills. 2000 w. Engr—Apr. 19, 1918. Difficulties encountered and efforts being made to extend their successful use.

Furnace Air

Temperatures of Furnace Air and Flue Gases (86258). W. F. Schaphorst. 1500 w. Pwr Pt Eng—May 15, 1918. Saving due to increasing temperature of air supplied and decreasing flue gas temperature.

Grate Area

Figuring Furnace-Grate Area (86556). Ills. 2500 w. Power—May 28, 1918. Rules followed by a number of manufacturers.

Leaks

Capitalization Value of Steam Leaks (86092). R. von Fabrice. Chart. 1000 w. Power—May 7, 1918. Capitalization value from saving a pound of steam per hour.

Pitch

Pitch As A Fuel (86479). 2000 w. Times Engng Supp—Apr. 26, 1918. Its use for firing steam boilers.

Soot

Soot, Its Effects, and Removal (86005). Charles L. Hubbard. Ills. 2500 w. Natl Engr—May, 1918. Nature of soot and its insulating effects; removal and types of soot blowers.

Steam Practice

Investigation of the Uses of Steam in the Canning Factory (86189 A). Julian C. Smallwood. Ills. 5500 w. (Abstract.) A S M E, Jl—May, 1918. Principles and best practice in the use of steam.

Value of Higher Steam Pressures (86205). J. T. Foster. 800 w. Elec Wld—May 11, 1918. Statement of yearly saving which can be realized from higher steam pressures.

Steam Turbines

Advantages of Superheated Steam and Its Effect on Turbine Efficiency (86207 A). Eskil Berg. 1500 w. Am Soc Mar Dftn, Jl—Jan., 1918. Explains reasons for its great economical value.

Turbine Bearings

Some Notes on Turbine Bearings and Their Lubrication (86359). Charles H. Bromley. 2000 w. Power—May 21, 1918. Data gathered from many sources.

TRANSPORTING AND CONVEYING

Coal Handling

Labor-Saving Coal Handling for the Factory Power House (86560 A). Reginald Trautschold. Ills. 6500 w. Ind Man—June, 1918. Conveying machinery used in modern power houses. Compares costs of various types.

Conveying Plant

Layout of a Modern Conveying Plant (86178). Ills. 2500 w. Auto Ind—May 9, 1918. Three systems installed in factory at Wayne, Mich., showing latest practice in gravity, overhead, and chain methods.

Cranes

See same heading under INDUSTRIAL MANAGEMENT, *Welfare and Safety.*

Handling

Typical Mechanical Handling of Miscellaneous Articles (86561 A). A. B. Proal, Jr. Ills. 1500 w. Ind Man—June, 1918. Gives typical installations for handling classified material. No conveyor is capable of handling all kinds of goods.

Hoist

A 35-Ton Wagon Hoist for Steel Works (86360 A). Ills. 1400 w. Elec Rev—Apr. 19, 1918. An installation of electrically-driven hoisting machinery recently put in service in England.

ELECTRICAL ENGINEERING

COMMUNICATION

Telegraphy

I Telegrafi In Italia (86464 B). I. Brunelli. 1000 w. L'Industria—Mar. 31, 1918. Development and status of the telegraph system in Italy.

Telephone Conduits

Construction Methods and Equipment Employed in Construction of Suburban Telephone Conduits (86124 A). Ills. 1500 w. Min Eng—May, 1918. Data on construction with trenching machine in suburban districts.

Telephony

Manual, Automatic, or Semi-Automatic? (86235 A). F. A. Wolff and G. S. Macomber. 8 pp. Tel Engr—May, 1918. Discussion of the relative advantages and limitations. United States Bureau of Standards report on the Washington situation.

Traffic Conditions and the Manager (86325). W. I. Howard. 2500 w. Telephony—May 18, 1918. Mechanical operation of the plant as distinguished from its manual operation. Relations of manager to the traffic requirements.

I Telefoni In Italia (86461 B). L. A. Zanni. 3200 w. L'Industria—Mar. 15, 1918. Development and growth of the telephone system in Italy.

Train Telephone

Telephone Reaches a Moving Train (86102 A). Ills. 1400 w. Ry & Loc Eng—May, 1918. Test made by the Canadian Government.

ELECTRO-CHEMISTRY

Batteries

Large Storage Batteries (86490). 1500 w. Times Engng Supp—Apr. 26, 1918. Use of such batteries in power stations.

Electric Furnaces

Electric Furnaces for Heat Treatment (86146 A). T. F. Baily. Abstract of paper before Cleveland Soc. of the Assn. of Iron and Steel Elec. Engrs. Ills. 2500 w. Iron Age—May 9, 1918. Types of resistance furnaces.

Fulton's Electric Zinc Furnace (86305 A). Ills. 1500 w. Met & Chem Eng—May 15, 1918. Details of a zinc smelting process devised by Charles H. Fulton.

Stobie 15-Ton Electric Furnace (86393 A). Ills. 2500 w. Ir & Cl Trds Rev—Apr. 12, 1918. Commercial possibilities of large as compared with small electric furnaces, with description of furnaces named.

Electrochemical Industries

The Future of the American Electrochemical Industry (86298 A). S. W. Maher. 1300 w. Met & Chem Eng—May 15, 1918. Factors likely to affect the future development, with particular reference to advantages offered by the South.

The Possibilities for the Devolpment of Chemical Industries in the Southern States (85996 A). Richard K. Meade. 3500 w. Met & Chem Eng—May 1, 1918. Survey of the power, fuel and basic raw materials suitable for chemical development.

Nature's Gift to the Electrochemist at Muscle Shoals (85992 A). Willis G. Waldo. Ills. 2500 w. Met & Chem Eng—May 1, 1918. Outlines the hydro-electric project on the Tennessee River, reviewing the universal resources of the region and the possible development of industry.

Electroplating

What Is the Matter With My Nickel Solution? (86010). E. P. Later. 3000 w. Fndry—May, 1918. Difficulties of the plates considered and some remedies.

ELECTRO-PHYSICS

Electromagnets

Solenoids and Electromagnets (85978 A). Charles A. Clark. Ills. 2500 w. Machy—May, 1918. Principles, proportions, and applications in various kinds of machines.

Filter Presses

Washing in Filter Presses (86300 A). D. R. Sperry. Ills. 1500 w. Met & Chem Eng—May 15, 1918. Considers in detail the construction and operation of filter presses for various industrial uses. Fourth part.

Hysteresis

Note Sur Les Pertes Dans Les Toles De Fer Aux Fréquences Élevées (86451 D). M. Latour. 2700 w. Bul Soc Internationale des Électricienes—Mar., 1918. Losses in iron plates at high frequencies: hysteresis and Foucault currents.

Loadstones

Galileo and Magnetism: A Study in Loadstones (86344 N). J. J. Fahie. Ills. 2500 w. Instn E E, Jl—April, 1918. Reviews Galileo's early researches in magnetism.

Mechanical Equivalent

L'Équivalent Mécanique De La Lumière (86456 B). A. Boutaric. 2500 w. L'Industrie Électrique—Apr. 10, 1918. Mechanical equivalent of light and calculation of radiation from different sources.

Radiography

See same heading under Illumination.

Reactance Coils

Repulsion and Mutual Inductance of Reactance Coils with the Same Axis (86019 A). H. B. Dwight. 1000 w. Elec Jl—May, 1918. Gives formulæ and results plotted in curves.

Reactors

Installation and Care of Reactors (86067). M. E. Skinner. 3000 w. Elec Wld—May 4, 1918. Factors of importance in their operation.

Thermionic Valve

The Evolution of the Thermionic Valve (86345 N). R. L. Smith-Rose. Ills. 9000 w. Instn E E, Jl—April, 1918. Explains the term and traces the development and uses.

Tungsten

Emissivity of Straight and Helical Filaments of Tungsten (86030 A). W. W. Coblentz. Ills. 17 pp. U S Bur Stds—April 6, 1918. Data on the radiation from the inside and outside of the turn of a helically wound tungsten filament in an atmosphere of nitrogen.

GENERATING STATIONS

Auxiliaries

Control of Station Auxiliaries (86204) Ills. 1000 w. Elec Wld—May 11, 1918. Methods used to good advantage by Chicago company.

Batteries

Large Batteries for Power Purposes (86429 N). E. C. McKinnon. Ills. 17 pp. Instn E E—April 25, 1918. Evolution, design, standardization, high-tension batteries, central station batteries, control, etc.

See also same heading under Electro-Chemistry.

Coal Conservation

Getting More Energy Out of Coal in the Power Plant (86328). Hartley LeH. [illegible] 1918. Points on low coal consumption and high efficiency.

Condensers

Pre-Charged Condensers in Series and in Parallel (86417 D). V. Karapetoff. 2000 w. A I E E, Pro—May, 1918. Investigates the action of a pre-charged condenser used as a booster in series with some source of e. m. f. for charging another condenser. Deduces the equations of a general network of such condensers. Explains Delon's apparatus.

Daylight-Saving

The Effect of Daylight Saving on Load (86203). 1600 w. Elec Wld—May 11, 1918. Data and curves showing how the daylight-saving law affects central stations in the middle west.

Electrical Plants

Progress in Electrical Power Plants (86507 A). Harry Webber. 7 pp. Keighley Assn Engrs—1916-17. Covers a period of about twenty years.

Electric Power

Relation of Load-Factor to Operating Cost of Electric Drive (86086). D. R. Shearer. 2500 w. Elec Rev, Chi—May 4, 1918. Importance of maximum demand and load-factor on charges for electric power.

Germany

Les Distributions D'Électricité En Allemagne (86498 B). J. De Soucy. Ills. 3200 w. Génie Civil—Apr. 27, 1918. Distribution of electrical energy in Germany. Present status and the tendency toward State monopoly.

Hydro-Electric

Hydro-Electric Power in Relation to Industry (85995 A). J. A. Johnson. 4500 w. Met & Chem Eng—May 1, 1918. Inquiry into the classification of industries and water-power developments with a view to securing efficiency.

Hydro-Electric Power in India (86487). 1200 w. Times Engng Supp—Apr. 26, 1918. Its present status and possible further development.

The Automatic Hydroelectric Plant (86416 D). J. M. Drabelle and L. B. Bonnett. Ills. 10 pp. A I E E, Pro—May, 1918. Plant at Cedar Rapids, Iowa.

Interconnection

Interconnected Power Systems of the South (85997 A). Ills. and Map. 10 pp. Met & Chem Eng—May 1, 1918. Hydro-electric systems of independent companies operating in five states are connected into one vast transmission system.

Rates

Engineering Data Necessary for an Electric Rate Determination (86424 B). Bert H. Peck, with discussion. 27 pp. West Soc Engrs, Jl—Jan., 1918. Outlines methods followed, showing how diversified an investigation is essential.

Stations

Six-Unit Station Will Develop 165,000 Kw. (86068). Ills. 2000 w. Elec Wld—May 4, 1918. Features of the latest additions to the Northwest Generating Station of the Commonwealth Edison Co.

Future Location of Central Power Stations (86093). Dever C. Ashmead. Map. [illegible] Power—May 7, 1918. Suggests that the country be divided into districts each served by electric power generated by central stations located at sources of fuel supply.

New 20,000-Kilowatt Steam Plant at Waterloo (86552). Ills. 2000 w. Elec Rev, Chi—May 25, 1918. New turbine station nearing completion in Iowa.

Summer Load

Economic Aspects of Summer Load (86532). 1800 w. Elec Wld—May 25, 1918. Serial, 1st part. Features of a class service which yields profitable revenue.

GENERATORS AND MOTORS

Alternators

Sudden Short Circuits of Alternators (86337). N. S. Diamant. 2500 w. Elec Wld—May 18, 1918. Critical exposition of electromagnetic phenomena attending sudden short circuits.

Sustained Short-Circuit Phenomena and Flux Distribution of Salient-Pole Alternators (86415 D). N. S. Diamant. Ills. 60 pp. A I E E, Pro—May, 1918. Shows that all the complicated phenomena of s. s. c. can be explained by taking proper account of certain details and secondary effects.

Notes on the Maintenance of Turbo Alternators (86132 A). L. Fokes. Ills. 5500 w. Colly Gdn—Apr. 12, 1918. Systems of ventilation; air filtering; cleaning; over excitation, etc.

The Commutator Machine as the Standard Single-Phase Type (86361 A). F. Creedy. Abstract of paper before the Assn. of Supervising Electricians. 2200 w. Elec'n—Apr. 19, 1918. Serial, 1st part. Advances claims for the universal employment of the commutator motor on single-phase circuits to the exclusion of the single-phase induction motor.

Asynchronous Motors

Moteurs Asynchrones A Courants Alternatifs (86455 B). J. A. Montpellier. Ills. 3300 w. L'Industrie Électrique—Apr. 10, 1918. Serial, 1st part. Asynchronous motors on alternating current under conditions of short circuited rotor.

Automatic Control

Automatic Control for Electric-Motors (86343 N). Frank Broadbent. Ills. 1600 w. Beama Jl—April, 1918. Typical applications illustrating method.

Flashing

The Flash Suppressor (86017 A). N. W. Storer and F. T. Hague. Ills. 3500 w. Elec Jl—May, 1918. Suppresses the causes of flashing. Describes tests.

Inductor Type

Characteristics of the Inductor Type Generator (85962). Millard C. Spencer. Ills. 3000 w. Elec Rev, Chi—Apr. 27, 1917. Standard type for wireless stations. Method of operation, testing, etc.

Machine Output

Versuch technische Beiträge zur Auslaufmethode (86469 B). A. Imhof. Ills. 3700 w. Schweiz Elektrotech Verein Bul—Mar., 1918. Review of methods for determining the output of machines of different sizes; iron losses, etc.

Motors

Braking of Electric Motors (86020 A). E. M. Bouton. Ills. 4500 w. Elec Jl—May, 1918. Dynamic braking principles and applications, advantages and disadvantages; friction brakes, etc.

Electric Motors (85988). Gordon Fox. Ills. 4000 w. Pwr Pt Eng—May 1, 1918. Serial, 1st part. Types of machines, their construction and characteristics.

Performance of Polyphase Induction Motors (85947). Justin Lebovici. Ills. 2500 w. Elec Wld—Apr 27, 1918. Compares commonly used types. Points on which choice should depend.

ILLUMINATION

Churches

L'Éclairage Électrique Des Églises (86470 B). A. Boutaric. Ills. 3000 w. L'Industrie Électrique—Apr. 25, 1918. Arrangement and intensity of lighting units for church interiors.

Department Stores

The General Level of Illumination Intensities in Large Department Stores of New York City (86272 C). W. F. Little and J. F. Dick, with discussion. 3300 w. Ill Eng Soc, Trans—Apr. 30, 1918. Report of a recent investigation.

Illumination Design

Fundamentals of Illumination Design (86002 A). Ward Harrison. Ills. 10 pp. Gen Elec Rev—May, 1918. Serial, 1st part. Outlines principles entering into illumination design.

Indirect Lighting

An Indirect Lighting System in a Textile Plant (86273 C). George Wrigley. Ills. 5000 w. Ill Eng Soc, Trans—Apr. 30, 1918. Describes a system using the largest approved size high efficiency incandescent lighting unit, arranged to give the best possible working conditions.

Industrial Lighting

Industrial Lighting Curtailment (86407). C. E. Clewell. Ills. 2500 w. Am Mach—May 23, 1918. Question of coal conservation. Quantity of light used for shop purposes none too great.

Mechanical Equivalent

See same heading under Electro-Physics.

Office Lighting

Lighting of Offices and Drafting Rooms (86355). Ward Harrison. 2500 w. Elec Rev, Chi—May 18, 1918. Serial, 1st part. Discusses office lighting on modern lines—quantity and quality of light needed.

Photometers

See same heading under Measurement.

Radiography

Single-Impulse Radiography (Instantaneous): Its Limitations and Possibilities (86141 N). Robert Knox. 5000 w. Instn E E—April 11, 1918. Apparatus; development of method; uses.

Schools

Report on Code of Lighting School Buildings (86271 C). Ills. 15 pp. Ill Eng Soc, Trans—April 30, 1918. Aims to serve as a guide in improving lighting conditions.

MEASUREMENT

Alternating Currents

Precise Measurement of Alternating Currents (86206). C. O. Gibbon. Ills. 2000 w. Elec Wld—May 11, 1918. Elements of two identical electrodynamometers so connected in Wheatstone bridge that a. c. through elements can be ascertained by measuring d. c. that produces zero torque.

Galvanometers

A Study of Electromagnetic Moving Coil Galvanometers for Use in Alternating-Current Measurements (86027 A). Ernest Weibel. Ills. 35 pp. U S Bur Stds—April 6, 1918. Theory, construction and performance, uses.

Graphic Wattmeters

The Value of Graphic Instruments in Improving Motor Drive (86356). T. S. Montgomery and W. B. Bray. Ills. 1500 w. Elec Rev Chi—May 18, 1918. Graphic wattmeters permit detail study and improved operation of motors.

Inductance

Self-Inductance of Short Reactance Coils (86530). H. B. Dwight. 800 w. Elec Wld—May 25, 1918. Formulas and methods of using information derived.

Induction Meters

Influence Des Variations Journalières De La Fréquence Sur Les Indications Des Compteurs D'Induction (86450 D). A. Durand. 3400 w. Bul Soc Internationale des Électriciens—Mar., 1918. Influence of daily variations on accuracy of induction type meters.

Iron Properties

Thermoelectric Measurement of Critical Ranges of Pure Iron (86026 A). George K. Burgess and H. Scott. Ills. 1800 w. U S Bur Stds—April 6, 1918. Investigations, giving methods and results.

Loads

Predicting Load on Residence Circuits (86202). P. O. Reyneau. 1600 w. Elec Wld—May 11, 1918. Data of assistance in making estimates of future requirements.

Magnetic Uniformity

Determination of the Degree of Uniformity of Bars for Magnetic Standards (86025 A). Raymond L. Sanford. Ills. 2500 w. U S Bur Stds—April 6, 1918. Describes method for determining the degree of magnetic uniformity along the length of a straight bar; effect of non-uniformities, etc.

Photometers

An "Average Eye" for Heterochromatic Photometry, and a Comparison of a Flicker and an Equality-of-Brightness Photometer (86029 A). E. C. Crittenden and F. K. Richtmyer. 26 pp. U S Bur Stds—April 6, 1918. Experimental data, showing the difference to be expected in individuals.

Wire Sizes

Determination of Economical Power Circuits (86528). P. O. Reyneau. 1200 w. Elec Wld—May 25, 1918. Method of deriving curves which show the most economical wire size.

POWER APPLICATIONS

Bakery

Operating Features of Motor Drive in a Bakery (86084). Ills. 1000 w. Elec Rev, Chi—May 4, 1918. Central Station service used by Century Biscuit Co., Indianapolis.

Cooking

See Kitchens, under INDUSTRIAL MANAGEMENT, *Welfare and Safety*.

Clutch

Electro-Magnetic Clutch for a Planing Machine (86250 A). Ills. 1800 w. Engr—April 26, 1918. Details of what is claimed to be a thoroughly practical magnetic clutch, manufactured in Kilmarnock.

Diathermy

Diathermy: The Use of the Electrical Current to Raise the Temperature of the Body in the Treatment of Disease (86142 N). E. P. Cumberbatch. 2000 w. Instn E E—April 11, 1918. The current used; construction of diathermy machine; application, etc.

Fuel

Fuel Economy and Electricity (86489). 1000 w. Times Engng Supp—Apr. 26, 1918. Possibilities of coal saving by installation of various electrical appliances for domestic use.

Heating

Elektrische Wärmeerzeugung für industrielle Anlagen (86467 B). F. Rutgers. Ills. 2700 w. Schweizerische Bauzeitung—April 27, 1918. Various examples of electric heating for manufacturing operations. Core ovens, water heating, etc.

Reduction Gears

An Interesting Application of a Reduction Gear (86018 A). T. E. Keating. Ills. 1500 w. Elec Jl—May, 1918. Details of an installation at Hastings, W. Va., which has proved successful in four years of service.

Rolling Mills

Rolling Mills and Their Electrical Equipments (86379 A). G. M. Brown. Abstract of paper read before the Cleveland Instn. of Engrs. 3500 w. Ir & Cl Trds Rev—March 1, 1918. Serial, 1st part. Determining the electrical plant necessary for a specified output, etc.

Steel Plant

Electrical Equipment of the Mark Steel Plant (86199). Joseph P. Collopy. Ills. 3000 w. Elec Rev, Chi—May 11, 1918. Complete electric drive in large new plant manufacturing steel conduit, pipe and plates.

Water Works

See Electrification, under CIVIL ENGINEERING, *Water Supply*.

Winding Engines

Electric Winding Engines (86131 A). John F. Perry. 3000 w. Elec'n—April 5, 1918. Describes chief systems and discusses their merits as compared with steam methods.

TRANSFORMERS

Current-Transformers

Current-Transformer Connections (85971). W. R. Woodward. Ills. 1600 w. Power—Apr. 30, 1918. Describes two types of construction, and discusses the reverse "V" and the star connections.

Inspection

Transformer Inspection as Economic Measure (85949). Ills. 4000 w. Elec Wld—Apr. 25, 1918. Methods of caring for apparatus and detecting flaws.

TRANSMISSION AND DISTRIBUTION

Conduits

Some Comments on Conduit Benders (85964). Terrell Croft. Ills. 700 w. Elec Rev, Chi—Apr. 27, 1918. Serial, 1st part. Describes types and comments on their use.

Earthing

The Development of an Efficient Earthing System (86383 A). J. P. Forster. Read before Assn. of Min., Elec. Engrs. Ills. 6000 w. Ir & Cl Trds Rev—March 29, 1918. Experiences in the earthing of a large electrical system feeding a group of mine collieries.

Germany

See same heading under Generating Stations.

Interconnection

Operation of Interconnected Systems (86335). J. P. Jollyman. Ills. & Map. 1200 w. Elec Wld—May 18, 1918. Experiences in connection with one of the most extensive inter connected networks.

Lightning Arresters

Lightning Arrester Spark Gaps (86418 D). Chester T. Allcutt. Ills. 20 pp. A I E E, Pro—May, 1918. Describes a new form of high-voltage lightning arrester gap. Results of tests are highly favorable.

Les Nouvelles Normes Relatives à l'installation des Partonnerres (86468 B). 3800 w. Schweiz Elektrotech Verein Bul —Mar., 1918. New standards for installation and maintenance of lightning conductors on buildings adopted by Swiss Association of Electrical Engineers.

Line Construction

Standardization of Overhead Construction (85948). H. E. Wulfing. Ills. 1700 w. Elec Wld—Apr. 27, 1918. Considerations that determined the types of line construction now used.

Lines

Special Transmission-Line Problems (86066). Ills. 2500 w. Elec Wld—May 4, 1918. How some difficulties peculiar to long spans have been overcome.

Iron Wire for Transmission Lines (85963). W. T. Ryan. 1500 w. Elec Rev, Chi—Apr. 27, 1918. Relative advantages of iron and copper.

Load Centers

Determining of Load Centers of Circuits (86231). Terrell Croft. Ills. 1200 w. Power—May 14, 1918. Explains the location of load centers of electric circuits.

Overcharged Wires

Court Decisions on Accidents from Overcharged Service Wires (86553). Chelsea C. Sherlock. 1800 w. Elec Rev, Chi—May 25, 1918. Resume of several important cases.

Poles

Substitutes for Cedar Poles (86236 A). L. M. Klauber. Ills. 1800 w. Tel Engr—May, 1918. Part of the report of the Engineering Committee for the Pacific Coast section, N. E. L. A.

Switching

Safety Features in Switching Installations (86529). M. M. Samuels and F. N. Bechoff. 2000 w. Elec Wld—May 25, 1918. Recommendations.

Underground

Interesting Underground Distributing System at Astoria, Oregon (86200). Ills. 1200 w. Elec Rev, Chi—May 11, 1918. Details of convenient routing of gas, telephone and electric systems.

CIVIL ENGINEERING

BRIDGES

Abutments

Bridge Abutment Has Pier Footings and Curved Wings (86444). Jonathon Jones. Ills. 1000 w. Eng News-Rec—May 23, 1918. Old creek bed necessitates special abutment and wing design for undergrade bridge.

Design

Continuous Trusses of Silicon Steel Feature New Allegheny River Bridge (86041). Ills. 4500 w. Eng News-Rec—May 2, 1918. Departure from precedent in bridge design; minimum weight desired for economy and to facilitate cantilever erection.

Esthetics in Bridge Design (86352). J. A. L. Waddell. Ills. 3300 w. Ry Rev—May 18, 1918. From a paper in *The American City, N. Y.* Beauty and harmony.

Earthquake Damage

Guatemala Earthquake Shifts Steel Viaduct on Its Piers (86442). W. T. Penney. 1000 w. Eng News-Rec—May 23, 1918. Tower legs move several inches on their bases in different directions.

Hell Gate

The Hell Gate Arch Bridge and Approaches of the New York Connecting Railroad Over the East River in New York City (85923 D). 1000 w. A S C E, Pro—April, 1918. Continued discussion of O. H. Ammann's paper.

Trestle

Reinforced Concrete Railway Trestle at Toronto (85935). Arthur F. Wells. Ills. 1000 w. Can Engr—Apr. 25, 1918. New 3-track structure. Premoulded concrete T-slabs rest on concrete bents supported on concrete spread footings.

CONSTRUCTION

Coal Waste

Suggestions for Saving Coal in Construction Operations (86282). George E. Ladd. Notes from *Public Roads*. 3000 w. Eng & Con—May 15, 1918

Concrete

Two New Designs of Houses of Concrete Throughout (86291). Ills. 900 w. Eng News-Rec—May 16, 1918. One has units poured in wire cloth forms with air space in walls, other uses cement-gun and pre-cast beams.

Unit-Built Concrete Dwellings at Youngstown, Ohio (86226). Harvey Whipple. Ills. [illegible] Ir Age—May 11, 1918. Details of fireproof dwellings for Youngstown Sheet and Tube Co.

Emergency Construction

Emergency Construction Work Due to War Conditions, with Especial Reference to the Construction Division of the Army (86549 D). George W. Fuller. 70 pp. A S C E, Pro—May, 1918. Deals particularly with the housing of the new U. S. National Army, and lessons from experience with emergency construction work.

Floors

The Flat-Slab System—A Topical Discussion (86409 B). Ills. 37 pp. Engrs' Soc W Penn, Pro—Feb., 1918.

What Is a Good Concrete Floor? (86565 A). Leonard C. Wason. 2200 w. Ind Man—June, 1918. Methods of preparing and laying such floors; treatment of the material after it is placed, etc.

Housing

Housing the Low Paid Workman (86162 D). William Roger Greeley. Ills. 1500 w. Arch For—April, 1918. Experiment in government aid under direction of the Massachusetts Homes Commission.

Housing Our Shipyard Workers (86105 A). Waldon Fawcett. 2500 w. Int Mar Eng—May, 1918. Delayed by lack of housing facilities.

Housing the Single Worker (86164 D). Walter H. Kilham. Ills. 3500 w. Arch [illegible] board [illegible]

Housing Types for Workmen in America (86156 D). Charles C. May. Ills. 3500 w. Arch For—April, 1918. Survey of various types used and their prime essentials discussed.

Jefferson Rouge, the Development of Solvay Process Company, Detroit, Mich. (86157 D). Ills. 500 w. Arch For—April, 1918. Plans carried out by Mann & MacNeille, architects and town planners.

The Multifamily House for Industrial Housing (86573 A). Henry Atterbury Smith. Ills. 700 w. Ind Man—June, 1918. Method of development to secure housing efficiency and economy.

Living Close to the Melting Pot (86163 D). Marguerite Walker Jordan. Ills. 3000 w. Arch For—April, 1918. Suggestions for meeting conditions of housing imposed by foreign-born laborers.

Methods of Economy in Housing Construction (86158 D). Charles A. Whittemore. 3502 w. Arch For—April, 1918. Suggestions that make for economy and phases of the problem

The Architect's Relationship to an Industrial Housing Development (86154 D). Perry R. MacNeille. 2500 w. Arch For—April, 1918. Outlines the general organization and methods for handling.

The Essential Principles of Industrial Village Development (86152 D). John Nolen. Ills. 4000 w. Arch For—April, 1918. Problems in industrial community development are discussed in detail.

The Financial Aspect of Industrial Housing (86160 D). C. Stanley Taylor. [illegible] w. Arch For—April, 1918. Study of projects for financing plans for better housing of workers.

War Time Housing—A Supreme Opportunity (86151 D). Andrew Wright-Crawford. Ills. 2500 w. Arch For—April, 1918. The effect of poor housing, the standards in England and Scotland, and the needs of America.

Industrial Towns

Broader Economy in the Maintenance of an Industrial Village (86161 D). Horace B. Mann. 2500 w. Arch For—April, 1918. Analysis of economical maintenance and management

Elmwood Park, Bethlehem, Pa. (86155 D). George S. Welsh. Ills. 700 w. Arch For—April, 1918. Development for housing workmen of the Bethlehem Steel Co.

The Development of the Midvale Steel Company, Coatesville, Pa. (86113 D). W. Leslie Walker. Ills. 1100 w. Arch For—April, 1918. Describes town planned with a view to health and happiness.

Tyrone, New Mexico, the Development of Phelps-Dodge Corporation (86150 D). Ills. 1000 w. Arch For—April, 1918. Work of Bertram Grosvenor Goodhue. Details of houses.

Reinforced Concrete

Revised Code of Bureau of Yards and Docks for Design of Reinforced Concrete Structures (86437). 2500 w. Eng & Con—May 22, 1918. Main features of the revised code.

Swimming Pool

Large Outdoor Swimming Pool Built in Circular Form (86441). C. E. Bliss. Ills. 1200 w. Eng News-Rec—May 23, 1918. Bottom increasing in depth toward center is paved with reinforced concrete.

IRRIGATION AND RECLAMATION

Drainage

The Outlook for Land Drainage for the Year 1918 (86122 A). A. H. Beitman. 1200 w. Mun Eng—May, 1918. Importance of reclamation of waste lands.

Reconstruction

Wooden Trestle Replaced Piecemeal by Concrete Structure (86046). Ills. 700 w. Eng News-Rec—May 2, 1918. Work in San Joaquin irrigation district.

Rio Grande

Big Returns from Irrigation in Lower Valley of the Rio Grande (86539). W. D. Hornaday. Ills. 1200 w. Mfrs Rec—May 23, 1918. Results from reclaimed land.

Sugar Beets

Sugar Beet Irrigation (86366 A). W. L. Powers. 900 w. Aust Min Stan—April 4, 1918. Methods and practices to be used in this form of beet culture.

MATERIALS OF CONSTRUCTION

Brick

Composition of Refractory Silica Brick (86527). J. S. McDowell. 2000 w. Eng & Min Jl—May 25, 1918. Changes in composition undergone by silica brick in the burning process.

Cements

Crystalloids Against Colloids in the Theory of Cements (86516 N). Henry Le Chateler. 2000 w. Faraday Soc—Jan., 1918. A study of the problem.

Is the Setting of Cement Mainly a Physical or a Chemical Process? (86520 N). John G. A. Rhodin. 1000 w. Faraday Soc—Jan., 1918. Investigations.

The Mechanism of the Setting Process in Plaster and Cement (86515 N). Cecil H. Desch. 3000 w. Faraday Soc—Jan., 1918. Examines hypotheses and the evidence adduced in their support, indicating the nature of discrepancies.

The Setting of Cement in Its Relation to Engineering Structures (86519 N). Bertram Blount. 1300 w. Faraday Soc—Jan., 1918. Theory and practical aspect.

Concrete

Effect of Alkali Soils on Concrete (86165). J. F. Greene. Abstract of paper before Can. Soc. of C. E. 1000 w. Eng & Con—May 8, 1918. Discussion with special reference to conditions in Western Canada.

Permeability of Concrete by Water (86348 A). B. J. Smart and A. Morrison. Read before Eng. Assn. of N. S. W. Ills. 2500 w. Aust Min Stan—Apr. 18, 1918. Report of tests, with review of work carried out by Wig and Bates.

Revolutionary Results Obtained by Proportioning Water in Concrete Tests (86047). Duff A. Abrams. 1500 w. Eng News-Rec—May 2, 1918. Importance of ratio of water to cement.

Mortar

Ancient and Modern Mortar (86522 N). W. J. Dibdin. 1700 w. Faraday Soc—Jan., 1918. A comparison.

Piling

Durability of Untreated Piling Above Mean Low Water (85933). Mabel E. Thorne and C. H. Teasdale. 2500 w. Eng & Con—Apr. 24, 1918. A study by the questionnaire method, made by the Forest Products Laboratory.

Portland Cement

The Constitution and Hydration of Portland Cement (86517 N). A. A. Klein. 4500 w. Faraday Soc—Jan., 1918. A study and review of the subject.

The Effect of the Addition of Suitable Slag on the Setting Properties of Portland Cement (86521 N). E. Deny and E. H. Lewis. 1200 w. Faraday Soc—Jan., 1918. Research work.

The Setting and Hardening of Portland Cement (86518 N). G. A. Rankin. 3000 w. Faraday Soc—Jan., 1918. The constitution of Portland cement clinker, discussing the hydration of the constituents.

Reinforced Concrete

Reinforced Concrete Theory Without the Aid of Formulas (86283 A). Charles A. Ellis. 4000 w. Eng Ed—April, 1918. Serial, 1st part. Explains how a course in the theory might be conducted.

T-Beams

Reinforced Concrete T-Beam Design and Investigation (86285 A). W. C. Huntington. 3500 w. Univ Col Jl Eng—April, 1918. Deals primarily with moment calculations. Diagram and formulas.

Timber

Effect of Moisture Reabsorption on Compressive Strength of Air-Dried Timber (86186 A). Irving H. Cowdrey. (Abstract.) 4000 w. A S M E, Jl—May, 1918. Investigations and conclusions.

Victorian Forests and Their Management (86347 A). Ills. 1300 w. Aust Min Stan—Apr. 18, 1918. Serial, 1st part. Primary needs of the timber industry.

Wooden Containers

The Use of Wood in Chemical Apparatus (86302 A). A. W. Schorger. 3500 w. Met & Chem Eng—May 15, 1918. Results of an inquiry by the Forest Products Laboratory regarding experience with wooden containers.

MEASUREMENT

Hell Gate Bridge

Stress Measurements on the Hell Gate Arch Bridge (85924 D). Ills. 3500 w. A S C E, Pro—April, 1918. Continued discussion of paper by D. B. Steinman.

Weirs

Verification of the Bazin Weir Formula by Hydro-Chemical Gaugings (86,551 D). 20 pp. A S C E, Pro—May, 1918. Continued discussion of paper by Floyd A. Nagler, Jr.

MUNICIPAL

Activated Sludge

The Fertilizing Value of Activated Sludge (86021 B). George G. Nasmith and G. P. McKay. Ills. 2800 w. Jl Ind & Eng Chem—May, 1918. Report of experiments showing it a most valuable fertilizer.

City Building

Engineering Features of the Social Hall Ave. Development (86546 A). W. E. Turner. Ills. 2000 w. Utah Soc Engrs, Mthly Jl—March, 1918. Work in Salt Lake City in street planning, etc.

Refuse

Garbage and Refuse Disposal on the Mesaba Iron Range, Minnesota (86264 A). E. J. Hawley. 2000 w. Af Eng Soc Minn, Bul—May, 1918. Types of incinerators used in three municipalities.

Sanitation

Some Experimental Apparatus for Sanitary Engineers (86143 A). Charles L. Walker. Ills. 1200 w. Corn C E—March, 1918. Apparatus for determining the number of bacteria in air, and for measuring small amounts of gas used as a disinfectant.

Sewage Treatment

Recent Improvements to Sewage Treatment Plant at Alliance, Ohio (86,119 A). R. Winthrop Pratt. Ills. 2000 w. Mun Eng—May, 1918. History of sewage treatment at Alliance, recent improvements and details of plan.

Some Points Worth Considering in the Design of Sewage Treatment Works (86121 A). John H. Gregory. 1800 w. Mun Eng—May, 1918. General arrangement and accessibility, grit chambers, screens, open channels, tool house and other details.

Sewerage

Water Supply and Sewerage of Recreation Camps at Lake Geneva, Wisconsin (86117 A). W. S. Shields. Ills. 1200 w. Mun Eng—May, 1918. Sanitary requirements.

Sewers

Method and Cost of Making Light Joints in Pipe Sewers (86118 A). W. W. Dixon. Ills. 1000 w. Mun Eng—May, 1918. The value of G-K compound in stopping infiltration.

ROADS AND PAVEMENTS

Concrete Roads

Methods and Cost of Constructing a Concrete Road in Southern California (86003). E. Earl Glass. Ills. 1200 w. Eng & Con—May 1, 1918. Replacing an oiled earth road with 3.62 miles of bituminous surfaced concrete pavement on a disintegrated granite base.

Wear Resisting Values of Various Aggregates for Concrete Roads Indicated (86043). H. S. Mattimore. Ills. 1000 w. Eng News-Rec—May 2, 1918. New machine generates impact stresses. Results of tests on paving brick.

County Highways

The Rational Method of Determining Types of Roads for a County Bond Issue (86425 B). William Walter Marr, with discussion. 27 pp. West Soc Engrs, Jl—Jan., 1918.

Gravel Roads

Gravel Roads (86288 A). H. E. Phelps. 1800 w. Univ Col Jl Eng—April, 1918. Defects of construction and maintenance are considered.

Military Roads

Military Highways (86312 B). Logan Waller Page. 13 pp. Fkn Inst, Jl—May, 1918. Requirements, design, etc.

Military Road Building Difficult Even in America (86292). Frank W. Harris. 1500 w. Eng News-Rec—May 16, 1918. Experience shows maintenance to be the principal item.

Road Builders at Work Close to Front of American Sector in France (86293). Robert K. Tomlin, Jr. Ills. 2500 w. Eng News-Rec—May 16, 1918. Maintenance, reconstruction and quarrying proceed.

Pavements

Choosing Proper Grades for Various Types of Pavements (86115 A). William Alden Brown. 1300 w. Mun Eng—May, 1918. Adaptability of different types to various grades.

Construction Plant and Methods Employed in Building Reinforced Concrete Roads at Camp Custer, Battle Creek, Mich. (86112 A). George A. Burley. Ills. 2500 w. Mun Eng—May, 1918. Detailed description of the work.

Destruction of Wood Block Pavement Due to Use of Tar in the Creosote Oil (86113 A). P. C. Reilly. Ills. 800 w. Mun Eng—May, 1918. History of pavement laid in 1909 in Indianapolis.

Pavement Design and Construction (86111 A). George W. Tillson. Ills. 4000 w. Mun Eng—May, 1918. Development, joint filler, cushion, etc.

Some Design and Constructional Features of Modern Brick Pavements (86114 A). F. A. Churchill. Ills. 1800 w. Mun Eng—May, 1918. Monolithic and composite types are considered.

Philippines

Traffic Density Does Not Justify Building Roads for Heavy Trucks in Philippines (86294). J. L. Harrison. Ills. 3500 w. Eng News-Rec—May 16, 1918. Philippine conditions and the most economical kind of roads.

Snow Removal

Snow Removal Methods and Equipment for Rochester, New York (86004). From report of the Bureau of Municipal Research. 2200 w. Eng & Con—May 1, 1918. Study by John T. Child.

Tar Treatment

Tar Treatment of Streets and Bridges (86205 A). G. F. Barstow. 1800 w. Af Eng Soc Minn. Bul—May, 1918. Details of work in Stillwater, Minn.

Traffic Count

Analysis of the Traffic Count in Downtown Chicago (86545 B). George C. D. Lenth, with discussion. Ills. 90 pp. West Soc Engrs, Jl—Feb., 1918. The traffic problem and proposed Michigan Ave. improvement.

WATER SUPPLY

Catskill Supply

New York City's Catskill Mountain Water Supply (86500 B). Alfred D. Flinn. Ills. and Map. 37 pp. Prof Mem—May-June, 1918. Outline of the system, description of the works, etc.

Dam Failure

Failure of Part of the Calaveras Dam (86237 A). Ills. 1500 w. West Eng—May, 1918. Earth dam in California, 250 ft. high.

Dams

Construction Methods Used in Building the Lower Reservoir Dam of the Balmorhea Project (85922 D). Vernon L. Sullivan. Ills. 800 w. A S C E, Pro—April, 1918. Economical and practical methods of constructing earth dams.

Improving Arch Action in Arch Dams (86548 D). L. R. Jorgensen. Ills. 15 pp. A S C E, Pro—May, 1918. Reasons for arch shortening; crown deflections; deformations; outlining a method for pressure grouting spaces, etc.

Distribution

Improvements in Water Distribution System Under Efficient Organization (86185). R. S. Spalding. Ills. 1500 w. Eng News-Rec—May 9, 1918. Recent advances and savings in the water distribution system of Chicago.

Electrification

Electrification of Pumping Stations Saves Coal and Money (86183). Harrison R. Cady. Ills. 1000 w. Eng News-Rec—May 9, 1918. Philadelphia Water Bureau combines several small pumping, power and lighting loads at one of its smaller pumping and filtration plants.

England

Water Supply in the Midlands (86,491). 1700 w. Times Engng Supp—April 26, 1918. New water works of the Derwent Valley.

Filtration

Coal Pre-Filter Prevents Sand Accretion in Final Rapid Water Filters (86182). Ills. 1200 w. Eng News-Rec—May 9, 1918. Work at Lawrence, Kan., involves increased supply from wells, complete purification plant for iron and hardness removal.

France

Water-Supply at the front in France (86179). Robert K. Tomlin, Jr. Ills. 4000 w. Eng News-Rec—May 9, 1918. Engineering work for American forces centralized in specialists.

Industrial Plants

Watering and Unwatering an Industrial Plant and Its Relation to the Public Water Supply (86123 A). William F. Wilcox. 4000 w. Mun Eng—May, 1918. The problems of industrial supply, the difficulties and differences.

Metering

Meters Help But Are Not Sufficient to Control Waste (86184). 1200 w. Eng News-Rec—May 9, 1918. Successful methods at Oak Park, Ill.

Setting 25,000 Meters Cut Water Consumption at San Francisco (86180). George W. Pracy. Ills. 1200 w. Eng News-Rec—May 9, 1918. Methods and costs.

Pumping Station

Louisville Builds New Pumping Station on Huge Open-Well Caisson (86,181). Ills. 2000 w. Eng News-Rec—May 9, 1918. First foundation of this type on the Ohio River.

Purification

The Ozone Method of Water Treatment and Some Examples of Recently Installed Industrial Plants (86120 A). Irwin D. Groak. Ills. 1800 w. Mun Eng—May, 1918. Processes of water purification and the ozone process.

Waste

Water Waste (86270 A). Edward E. Wall. 5500 w. E Cb St L, Jl—March-April, 1918. Deals particularly with conditions in St. Louis.

Water-Works

Design and Construction of the New Municipal Dam and Hydro-Electric Power Plant at Fort Dodge, Iowa (86,116 A). Robert E. McDonnell. Ills. 1000 w. Mun Eng—May, 1918. Details of the project and its cost.

Wells

The Sinking and Lining of Large Bore Wells for Public Water Supplies (86197). W. H. Maxwell. Ills. 2500 w. Can Engr—May 9, 1918. Details of the work.

WATERWAYS AND HARBORS

Canals

Barge Canal Information (86432). [illegible] Methods of construction employed. Locks, dams, and gates described.

Future of British Canals (86435). [illegible]

The Canal System of New York State (86431). Ills. and Map. 3500 w. Naut Gaz—May 25, 1918. Practical information from handbook issued by Gen. W. W. Wotherspoon.

Waterways and the New York Barge Canal (86433). 5500 w. Naut Gaz—May 25, 1918. Statistics and economic principles of internal waterways in general and the N. Y. Barge Canal in particular.

Docks

Power Plant Docks (85989). R. von Fabrice. Ills. 1500 w. Pwr Pt Eng—May 1, 1918. Protection of water front and provision for docking coal barges.

Flood Control

Detention Reservoirs with Spillway Outlets as an Agency in Flood Control (86550 D). Ills. 20 pp. A S C E, Pro—May, 1918. Continued discussion of H. M. Chittenden's paper.

German Waterways

Lesson of the German Waterways (86436). 2000 w. Naut Gaz—May 25, 1918. Empire's commercial progress ascribed to development of rivers and canals.

Inland Waterways

Our Inland Waterways (86434). 4000 w. Naut Gaz—May 25, 1918. Development of terminals and facilities along the Mississippi, Ohio, and Missouri rivers.

Plans for the Development of Inland Water Transportation (86090). Walter Parker. 2000 w. Ry Rev—May 4, 1918. Argument for utilization of rivers and canals as adjuncts to the railroads.

Piers

Norfolk of Western Builds Terminal Piers at Norfolk (86290). F. P. Turner. Ills. 3500 w. Eng News-Rec—May 16, 1918. Timber sub-structure with steel-frame shed.

Piling

See same heading under Materials of Construction.

Trent

Trent Navigation Improvement (86488). Ills. 1300 w. Times Engng Supp—Apr. 26, 1918. Proposed improvement of river Trent between Nottingham and Newark, England.

Weirs

The New Fall Creek Weir (86144 A). W. G. McClintock. Ills. 1200 w. Corn C E—March, 1918. Details of construction.

MISCELLANY

Engineers

The Engineer in War (86427 A). J. F. Mangold. Ills. 14 pp. Pahasapa Qr—April, 1918. Phases of the work and achievements.

Engineer Troops

The Organization and Duties of Engineer Troops in the European War (86286 A). C. S. Sperry. 2500 w. Univ Col Jl Eng—April, 1918. Survey of the work of the engineer troops.

Military Engineering

Battle Front Transportation (86503 B). Roger Haydock. Ills. 29 pp. Prof Mem—May-June, 1918. System of railways, roads, and cableways put in operation.

Some Notes on the Turkish Trenches at [illegible] B). W. H. [illegible] Ills. 1800 w. Prof Mem—May-June, 1918. Describes the country and the trenches.

Suggestions on Trench Construction, etc. (86504 B). H. D. Trounce. 18 pp. Prof Mem—May-June, 1918. Various kinds of trenches, drainage, shelters, camouflage, transport, etc.

The Influence of Topography Upon the Strategy of the European War (86240 A). Frederick K. Morris. Ills. 5500 w. E Cb Phila, Jl—May, 1918. Interesting explanation of why certain fields for battles were chosen.

Trench Organization (86505 B). Rene Radiguet. Ills. 18 pp. Prof Mem—May-June, 1918. From "The Making of a Modern Army and Its Operations in the Field." General plan of an intrenchment system.

Tunnels and Galleries (86501 B). From *La France Militaire*. 800 w. Prof Mem—May-June, 1918. Works constructed by the Germans and also by the Allies. Design, construction and materials employed.

MARINE AND NAVAL ENGINEERING

Cargo Carrier

New Type of Cargo Carrier Wins Favor on Pacific (85929 N). R. C. Hill. 1600 w. Mar Rev—May, 1918. Details of a steel cargo vessel designed and built on the Pacific Coast.

Concrete Ships

Concrete Barges and Ships (86109 A). Ills. 3500 w. Int Mar Eng—May, 1918. Comparison with steel and wooden vessels. Report of joint committee.

Concrete Cargo Vessels (86309). T. G. Owens Thurston. Ills. Extracts from a paper read before the British Instn. of Nav. Archts. 2000 w. Naut Gaz—May 11, 1918. Construction of ferro-concrete ships, equipment, launching, etc.

Les Grands Cargos En Ciment (86493 B). H. Volta. Ills. 1200 w. La Nature—Apr. 13, 1918. Large merchant vessels being built in Germany and Norway.

Concrete Ships (86208 A). L. R. Ferguson, with short discussion. Ills. 2000 w. Am Soc Mar Dftn, Jl—Jan., 1918. The design, advantages, objections, etc.

Reinforced Concrete Ships (86256). Ills. 2500 w. Pwr Pt Eng—May 15, 1918. Launching of steamship "Faith," and the use of reinforced concrete as a shipbuilding material.

1000-Ton Ferro-Concrete Motor Vessel on the Alfsen System (86364 A). Ills. 600 w. Engng—April 26, 1918. Details of vessels built in Norway.

The History of Concrete Barge and Ship Construction (86438). J. E. Freeman. Abstract of paper before Eng. Soc. of Buffalo. 3000 w. Eng & Con—May 22, 1918.

Dry Dock

Champlain Dry Dock for Quebec Harbor (85900 N). U. Valiquet. Ills. 13 pp. Can Soc C E—April 25, 1918. History and description of the work; construction, equipment, etc.

Electric Control

Electric Controlling Appliances (86,209 A). W. E. Thau. Ills. 4000 w. Am Soc Mar Dftn, Jl—Jan., 1918. Third of a series of articles on electric appliances for shipboard service.

Marine Engineers

From a Lake Dredge to a Transatlantic Liner (85928 A). Ills. 3500 w. Mar Rev—May, 1918. True story of a retired marine engineer.

Merchant Marine

Future Design and Construction of Merchant Ships (86308). W. S. Abell. Abstract of paper read before the British Instn. Nav. Archts. 6000 w. Naut Gaz—May 11, 1918. Directions in which future research should be encouraged.

Naval Repairs

War-Time Repairs in the Navy (86,048). Frank A. Stanley. Ills. 3500 w. Am Mach—May 2, 1918. Serial, 1st part. Shows how repair work is handled on floating repair shops.

Propulsion

Ljungström Turbo-Electric Ship-Propelling Machinery (86372 A). Ills. and Plate. 2500 w. Engng—May 3, 1918. Serial, 1st part. Its application to a sea-going ship in England, explaining the principle of Ljungtröm turbine.

Pump Tests

Tests of Main Circulating Pumps of North Dakota and Nevada (86052 F). S. M. Robinson. Ills. and Plates. 2500 w. Am Soc Nav Engrs, Jl—Feb., 1918. Details of tests.

Safety

Safety at Sea (86485). 1300 w. Times Engng Supp—April 26, 1918. Different systems of signals for use between ships and shore stations, as well as between ships at sea.

Salvage

Salvage of the Argentine Naval Transport "Pampa" (86577 A). L. H. Chandler. Ills. 2500 w. U. S. Nav Inst, Pro—May, 1918. Salvage of a naval transport that went aground on the North Carolina coast in Dec., 1917.

Schooners

New Pacific Coast Steam Schooners (86108 A). Ills. 1700 w. Int Mar Eng—May, 1918. Interesting features of wooden lumber carriers.

Shipbuilding

Application of Reinforced Concrete to Ship Construction (85934). Allen Hoar. Ills. 1800 w. Eng & Con—Apr. 24, 1918. Essentials to success in the application of this material.

The Control of Shipbuilding (86486). 1300 w. Times Engng Supp Apr. 26, 1918. Reorganization by the British Shipbuilding Advisory Council. Negotiations with labor; standardizing of ships, etc.

Great Shipbuilding Activity at Pascagoula and Vicinity (86281). Charles E. Chidsey. Ills. 2500 w. Mfrs' Rec—May 16, 1918. Details of plant and work at Pascagoula, Miss.

How Can We Build More Ships? (86104 A). Joseph W. Powell. 1800 w. Int Mar Eng—May, 1918. Government agencies and shipbuilders must work together.

Rare Woods Used in Shipbuilding (85931 A). C. D. Mell. 500 w. Mar Rev—April, 1918. Serial, 1st part. Present article deals with mahogany and how it should be used.

Some Effects of War on Merchant Shipbuilding (86426 N). James Craig, with discussion. Ills. 30 pp. Instn E & S Scot, Trans—April, 1918. Effects on labor, materials, methods of work, and on design.

Shipping

State Controlled Shipping (86310). From article by John Hilton, in the *Edinburgh Review*. 7500 w. Naut Gaz—May 18, 1918. History of Britain's merchant fleet since the war. Official mistakes shown.

Shipyards

Shipyard of Columbia Engineering Works (86110 A). Ills. 1500 w. Int Mar Eng—May, 1918. Plant at Portland, Ore., for building wooden ships.

Shops

Man-O-War's Repair Shop is Unique (85927 A). Ills. 600 w. Mar Rev—May, 1918. Features of a modern battleship machine shop.

Signalling

Synchronous Signalling and Safety at Sea (86216 A). Abstracts of lectures by J. Joly, before the Royal Instn. 2000 w. Engr—Apr. 19, 1918. Considers additional aids to navigation to escape dangers from failure of aerial fog signals. Recent developments in methods of signalling.

Steam Winch

Power of a Steam Winch (86210 A). S. H. Cornell. Ills. 1000 w. Am Soc Mar Dftn, Jl—Jan., 1918. Analysis.

Submarines

The Work of British Submarines (86249 A). 1600 w. Engr—Apr. 26, 1918. Editorial on submarines of the Allies and especially the work of the British during the war.

Torpedo Explosions

Effect of Torpedo Explosions on the Structure of Merchant Ships (86106 A). 1200 w. Int Mar Eng—May, 1918. Report of committee of Instn. Nav. Archts. on cargo ships and mail and passenger vessels.

U. S. Shipping Board

U. S. Shipping Board: Its Handicaps and Accomplishments (86098). Edward N. Hurley. Ills. 2500 w. Mar Eng, Can—April, 1918. Address before Nat. Marine League, New York.

Wooden Ships

Build More Wooden Ships (86107 A). H. J. Roundy. 2500 w. Int Mar Eng—May, 1918. Plea for continuation of wooden shipbuilding.

How Wooden Ships Are Laid Off (85930 A). Samuel J. P. Thearle. Ills. 4000 w. Mar Rev—May, 1918. Serial, 1st part. Application of geometry to wooden shipbuilding.

MINING AND METALLURGY

BASE METALLURGY

Analysis

New Method of Determining Copper (86555). James Moir. 1200 w. Min & Sci Pr—May 25, 1918. Method for correct analysis dispensing with the large quantities of potassium iodide heretofore used.

Copper

Copper in 1916 (86139 N). B. S. Butler. 55 pp. U S Geol Surv, I: 20—Apr. 22, 1918. General report.

COAL AND COKE

Cables

The Care and Testing of Colliery Cables (86381 A). A. F. W. Richards: Read before meeting at Stoke-on-Trent. Ills. 6000 w. Ir & Cl Trds Rev—Mar. 22, 1918.

Carbocoal

Carbocoal (86411 D). Charles T. Malcolmson. 2500 w. A I M E, Bul—May, 1918. Process for the manufacture of smokeless fuel from high-volatile coals, and recovery and refinement of coal-tar products derived. Characteristics, uses, etc.

Coal

Determination of Sulphur in Coal (86333). Edwin M. Chance. 1800 w. Cl Age—May 18, 1918. Precautions needed to secure a correct evaluation of the sulphur.

Coal Distribution

Zone System for the Distribution of Bituminous Coal (86228). Map. 4 pp. Cl Age—May 11, 1918. Order of the Fuel Administration, with key to consuming districts.

Coal Handling

New Methods of Handling Coal Electrically (86334). C. L. Packard. Ills. 1500 w. Cl Age—May 18, 1918. Improvements introduced recently at a plant of H. C. Frick Coke Co.

See also same heading under MECHANICAL ENGINEERING, *Transporting and Conveying.*

Coal Mines

Mud Injection in Coal Mines (86211 A). Ills. 3300 w. Engng—April 12, 1918. M. Plassard urges this plan for extinguishing fires in collieries, for recovery of coal under unfavorable conditions, and for ensuring greater safety.

Coal-Seams

On the Splitting of Coal-Seams by Partings of Dirt (86317 N). Percy Fry Kendall, with short discussion. Ills. 3 plates. 20 pp. Instn Min Engrs, Trans—April, 1918. Serial, 1st part. Deals with splits that rejoin.

Coal Storage

The Storage of Bituminous Coal (86089). H. H. Stoek. 1200 w. Ry Rev—May 4, 1918. Résumé of a discussion before the Western Soc. of Engrs. Conclusions.

Coal Washing

Coal Washing: A Scientific Study (86316 N). Thomas James Drakeley, with short discussion. 40 pp. Instn Min Engrs, Trans—April, 1918. Scientific aspects of coal washing. Research work.

Coke

Byproduct Coke and Coking Operations (85944). C. J. Ramsburg and F. W. Sperr, Jr. Ills. 4000 w. Cl Age—April 27, 1918. Serial, 1st part. Information relating to this important industry.

Coke as Blast-Furnace Fuel (86388 A). G. W. Hewson. Abstract of paper and discussion before Soc. of Chem. Ind. 1800 w. Ir & Cl Trds Rev—April 5, 1918. Considered satisfactory if the hardness number is above 94.

Coke Ovens

New Regenerative Coke Oven Plant at Thornaby Ironworks (86346 A). Frederick C. Coleman. Ills. 1400 w. Colly Gdn—April 19, 1918. Detailed description.

Colliery Plants

Some Useful Instruments for Colliery Power Plants (86380 A). H. W. Ravenshaw. Abstract of paper and discussion before the Midland Inst. of Min., Civ. & Mech. Engrs. Ills. 3000 w. Ir & Cl Trds Rev—March 15, 1918. Deals mainly with recording and measuring instruments.

Notes on the Extending of Colliery Three-Phase Electrical Power Plant (86392 A). L. Fokes. 4500 w. Ir & Cl Trds Rev—April 12, 1918. Serial, 1st part. Considerations when ordering new plant to ensure that no difficulties will be encountered.

Compressed Air

Compressed Air in the Coal Mine (86263). Charles A. Hirschberg. Ills. 2500 w. Com Air—May, 1918. Methods and advantages; applications and work.

Concrete

Concrete in Coal Mine Service (86332). J. F. Springer. Ills. 4000 w. Cl Age—May 18, 1918. Gives details of applications.

Explosives

The Use of Permissible Explosives in the Coal Mines of Illinois (85943 A). James R. Fleming and John W. Koster. Ills. 102 pp. U S Bur Mines—Bul. 137. Deals with the use of permissible explosives in the coal mines of Illinois.

Fuel Conservation

Methods Employed to Aid Fuel Conservation (86353). 2500 w. Ry Rev—May 18, 1918. Abstracts of papers before the Pacific Ry. Club in San Francisco. Methods now in use for saving fuel oil; educating men, systematized effort and team work.

Fuels

An Investigation of the Fuel Problem in the Middle West (86190 A). A. A. Potter. (Abstract.). 3000 w. A S M E, Jl—May, 1918. Need of more adequate storage, greater fuel economy, and more careful regulation of quality to avert emergencies.

Fuel Economics (86277 N). D. B. Dowling. 4000 w. Can Min Inst, Bul—May, 1918. Fuel reserves, waste, etc.

Pulverized **Coal** for Industrial Purposes (86542). John Cutliffe. Read before Vancouver Cham. Mines. 4500 w. Cl Age—May 25, 1918. Shows that it offers advantages over other fuels.

Germany

Germany's Coal Industry During the War (86389 A). 2200 w. Ir & Cl Trds Rev—April 12, 1918. Reviews the industry up to Oct., 1916, when the censor stopped publication of statistics.

Glass

Notes on a Gas-Coke-Producer-Fired Glass Tank Furnace for the Production of White Glass (86375 A). A. B. Roxburgh. Ills. 1500 w. Engng—May 3, 1918. Detailed description.

Gravity Tracks

Gravity Track System at Anthracite Coal Breakers (86443). F. N. Rupprecht. Ills. 2500 w. Eng News-Rec—May 23, 1918. Advantages and disadvantages of five typical layouts.

Lignites

Combustion of North Dakota Lignites With Suggestions for Design of Furnaces (85970). Henry Kreisinger. Ills. 3000 w. Power—Apr. 30, 1918. Results of investigations in the use of lignite.

Lymn System

Lymn By-Product Producer-Gas Plant and the Utilization of Low-Grade Fuels (86401 A). Ills. 2200 w. Ir & Cl Trds Rev—Mar. 8, 1918. Details of the plant at the Fushun mines in Manchuria.

Mine Control

The Future Control of Coal Mines (86224 A). G. H. D. Cole, with discussion. 4000 w. Colly Gdn—Apr 26, 1918. Addresses at Newcastle favoring control by trade union.

Mine Supplies

Handling Material and Supplies at Coal Mines (86082). R. M. Magraw. Ills. 2500 w. Cl Age—May 4, 1918. Describes a centralized material storage where accounts are kept of everything.

Organization

Coal Company Organization (86345). W. W. [illegible]. [illegible] w. Cl Age—Apr. 27, 1918. Adoption of an efficiency system with good results.

Prices

Graphic Determination of Prices ([illegible]). J. H. Simpson. [illegible] w. Cl Age—May 25, 1918. Curves for determining the varying prices for different sizes of coal at the mine.

Steam Turbines

The Steam Turbine as Applied to Colliery Work (86377 A). P. J. Plevin. 2500 w. Ir & Cl Trd Rev—Mar. 1, 1918. Read before Assn. of Min. Elec. Engrs. Deals with effects of changes resulting from war conditions. Advantages of prime movers of different types under present conditions.

United States

Coals of the United States (86357). 2000 w. Power—May 21, 1918. Serial, 1st part. Gives proximate analyses of typical coals of the U. S., to be followed by articles on fuels and types of stokers and furnaces best adapted to them.

Vancouver

Coal Industry of Vancouver Island (86083). Robert Dunn. 1800 w. Cl Age—May 4, 1918. In flourishing condition. Development in progress.

Washery

New Steel Washery of the Locustdale Coal Company (86540). Wilbur L. Cross. Ills. 2500 w. Cl Age—May 25, 1918. Rapid erection work at Germantown, Pa.

Waste

Waste in Coal in Canada (86297 N). W. J. Dick, with discussion. 28 pp. Can Min Inst, Bul—May, 1918. The value and waste of coal.

GEOLOGY

Arsenic

Notes on the Geology of Jibbenbar and the State Arsenic Mine (86034 N). H. J Jensen. Ills. & Maps. 3000 w. Qnsd Gov Min Jl—Mar. 15, 1918. Location, physiography, geology, lodes, present prospecting operations.

Diamonds

The Formation of Diamond (86371 A). Charles A. Parsons. Ills. 5000 w. Engng—May 3, 1918. Lecture before the Inst. of Metals, May 2, 1918.

Manchester, Eng.

The Geology of Manchester as Revealed by Borings (86315 N). George Hickling, with bibliography and discussion. 2 Plates. 60 pp. Instn Min Engrs, Trans—April, 1918. Information from the investigation of the geology of the Lancashire Coalfield, dealing mainly with provings of strata in sinking boreholes to water bearing strata for supplying water for industries.

Petroleum Geology

Superficial Dip of Marine Limestone Strata. A Factor in Petroleum Geology (86262 B). Kirtley F. Mather. Ills. 2500 w. Ec Geol—May, 1918. Factors of importance to petroleum geologists.

Salt Domes

The Theory of Volcanic Origin of Salt Domes (86413 D). E. L. de Golyer. 5000 w. A I M E, Bul—May, 1918. Review of the various theories of volcanic origin for salt domes, discussing the supposed Mexican analogy.

IRON AND STEEL

Blast-Furnaces

Blast-Furnace Practice (86369 A). 6500 w. Engng—May 3, 1918. Report of Iron and Steel Institute Committee No. 2, for blast furnace practice in the United Kingdom.

Fuel Economy in Blast Furnaces (86370 A). T. C. Hitchinson. Ills. 2500 w. Engng—May 3, 1918. Conditions in the blast furnace that secure long life of furnace lining and the fuel economy resulting.

Carbonized Steel

The Penetration of Carbon (86051). Howard Ensaw. Ills. 1800 w. Am Mach—May 2, 1918. Value of parts made from carbonized steel depends upon thoroughness with which the work is done. Various phases of the work.

China

The Iron Ore of China (86137 A). 1000 w. Engr—Apr. 12, 1918. Japanese control of valuable mines in China.

Japanese Steel

Japanese Development in Steel Making (86279 A). Thomas T. Read. Map & Ills. 2500 w. Iron Age—May 16, 1918. Japan's resources, steel consumption and prospects. Dependence on Asiatic ores.

Machine Working

The Problem of Man-Power in Home Iron-Ore Supply Fields: Mechanical Appliances the Solution (86387 A). W. Barnes. Ills. 4000 w. Ir & Cl Trds Rev—Apr. 5, 1918. Describes the leading features of the principal machines used in working shallow deposits of iron ore.

Slags

Classification of Furnace Slags (86,081). Herbert Lang. 2500 w. Min & Sci Pr—May 4, 1918. Kinds of slags; difficulties, composition, etc.

Steel Plant

The Keystone Steel and Wire Company (86000 A). F. B. Crosby. Ills. 12 pp. Gen Elec Rev—May, 1918. History of a steel plant of the Middle West, with description of the process of manufacturing steel wire.

Steel

The History and Romance of Steel (86506 A). Arthur W. Shephard. 12 pp. Keighly Assn Engrs—1916–17. A review.

MINE OPERATION

Cement Gun

Use of the Cement Gun in the Coeur d'Alene Mining District (85968). Ills. 1200 w. Eng & Min Jl—April 27, 1918. Concreting a cribbed wall, a reservoir, ore bins, thickening tank and buildings, at a cost estimated at about two-thirds that of hand plastering.

Gas Ignition

The Possibilities of Gas Ignition by Miners' Electric Lamps (86386 A). L. Fakes. Ills. 2500 w. Ir & Cl Trds Rev—April 5, 1918. Results of tests made to determine under what conditions ignition is possible.

Haulage

Mine Trackage for Motor Haulage (85946). Dever C. Ashmead. 2500 w. Cl Age—April 27, 1918. Influence of condition of haulage tracks; hints on track maintenance.

Mechanical Mining

Some Personal Experiences in Mechanical Mining, and Peculiar Geological Features in a South Wales Colliery (86385 A). William Hopwood. Ills Read before Natl. Assn. of Col. Mgrs 3000 w. Ir & Cl Trds Rev—March 29, 1918. Details of work.

Mine Cafeteria

The Cafeteria at the Kerr Lake Mine (86526). H. E. Kee. Ills. 1200 w. Eng & Min Jl—May 25, 1918. The system and its operation, with advantages.

Mines Report

Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington in 1916 (86,024 N). C. N. Gerry. 65 pp. U S Geol Surv, I:18—March 14, 1918. Production, value, etc.

Mine Taxation

The Taxation, Rating and Valuation of Mines (86378 A). David Bowen, with discussion. Abstract of paper read before the Surveyors' Instn. 7800 w. Ir & Cl Trds Rev—March 1, 1918. Principles of taxation and taxing systems.

Mining Policies

Should Mining Companies Expand? (86077). P. B. McDonald. 1800 w. Min & Sci Pr—May 4, 1918. Policies pursued by different companies.

Reports

The Standardization of Directors' Reports for Mining Companies (86071). T. O. McGrath. 2500 w. Eng & Min Jl—May 4, 1918. Plea for uniformity in reports of directors to stockholders of mining companies.

MINES AND DISTRICTS

Canadian Metallurgy

Recent Advances in Canadian Metallurgy (86320). Alfred Stansfield. Read before Can. Soc. of Civ. Engrs. 4000 w. Can Fndman—May, 1918. Developments induced by war's demands.

Mineral Industry

The Mineral Industry After the War (86295 N). Alfred W. G. Wilson. 2000 w. Can Min Inst, Bul—May, 1918. Second excerpt from paper before C. M. I. Principal methods by which increased national revenue may be obtained from this industry.

Mine Valuation

Formulas for Mine Valuation (86396). W. W. Whitton. 3500 w. Min & Sci Pr—May 18, 1918. Deduction of the Hoskold formula for valuation. Importance of new formulæ.

Philippines

The Mineral Resources of the Philippine Islands for the Year 1916 (86421 N). Ills. 25 pp. Phil Bur Sci—1917. Includes Mineral Resources by Alvin J. Cox; Metal Mining and Coal Mining by V. E. Lednicky. Manufacture of Roofing Tiles; and the Rizal Cement Plant, by J. C. Witt.

Queensland

Queensland Mining Industry (86033 N). Map. 18 pp. Qnsd Gov Min Jl—March, 1918. Review of the year 1917 by the under secretary for mines.

Silver Spur Mine (86576 N). Lionel C. Ball. Ills. 8500 w. Qnsd Gov Min Jl—April, 1918. Recent developments and future prospecting. History, geology, ore deposits, etc.

Russia

L'Industria Minière Et Siderurgique De La Russie (86494 E). A. Gowry. 20,000 w. Mem Soc Ingénieurs De France—Oct.-Dec., 1917. Mineral and metallurgical industry of Russia in 1913, and its possible future development.

MINOR MINERALS

Aluminum

Annealing and Recrystallization of Cold-Rolled Aluminum Sheet (86301 A). Robert J. Anderson. Ills. 2500 w. Met & Chem Eng—May 15, 1918. Series of tests made on the effect of heat on the softening of cold-rolled sheet aluminum.

Barium Carbonate

Possible Sources of Barium Carbonate (86078). Samuel H. Dolbear. Ills. 800 w. Min & Sci Pr—May 4, 1918. Search for witherite; uses.

Calcium

Calcium, Calcium Carbide and Calcium Cyanamide (86367 A). Ills. 5000 w. Aust Min Stan—April 11, 1918 Importance of the carbide industry, manufacture, etc.

Carnotite Ores

Mining and Concentration of Carnotite Ores (86232 A). Karl L. Kithil and John A. Davis. Ills. 80 pp. U S Bur Mines—Bul. 103. The mining of carnotite ores by the National Radium Institute; grinding and sampling of shipping ore before chemical treatment; concentration of milling ore; costs of production.

Concentrates

Rare Metals Prices Question (85,951 A). 4000 w. Aust Min Stand—March 28, 1918. Australia molybdenum and tungsten concentrates. An explanation of the disabilities of concentrates producers from a technical, not a commercial, point of view.

Manganese

Manganese Deposits of Clark County, Nevada (85966). Fred A. Hale, Jr. Ills. 1700 w. Eng & Min Jl—April 27, 1918. Ore runs 40% and over in manganese and is low in phosphorus and iron.

Molybdenum

Molybdenum Mining at Climax, Colorado (86397). H. L. Brown and M. W. Hayward. Ills. 1500 w. Eng & Min Jl—May 18, 1918. Deposits containing 1% molybdenum sulphide are being developed near Leadville.

Potash

Potash from Wood Ashes (86304 A). C. T. Edgar. Ills. 1500 w. Met & Chem Eng—May 15, 1918. On the development of the potash industry in Michigan and Wisconsin.

The Concentration of Potash from Raw Materials Containing Only a Trace of This Element by Means of the Electric Precipitation of Flue Dust and Fume Cement Kilns (86022 B). B. F. Erdahl. 2500 w. Jl Ind & Eng Chem—May, 1918. Outlines experiments and gives results.

Recovery of Potash from Blast Furnace Gases (86475 A). 1000 w. Nature—April 25, 1918. Historical review of experimental work and results secured.

Southern Resources

Mineral Resources of the Appalachian South (85993 A). Ills. & Map. 11 pp. Met & Chem Eng—May 1, 1918. A symposium by southern state geologists on the raw materials suitable for chemical or metallurgical development.

Zirconia

Zirconia—Its Possibilities in Metallurgy (86283 A). Leopold Bradford. Abstract of paper read before the Birmingham Metallurgical Soc., with discussion. 3300 w. Ir & Cl Trds Rev—March 22, 1918. Its value as a refractory; its uses, etc.

OIL AND GAS

Hazards

Gasolene and Kerosene Hazards (86326). Ills. 1300 w. Telephony—May 18, 1918 Dangers in handling. Instructions in use of kerosene torches.

Oil Fields

New Texas Oil Fields a Center of Great Activity (86016). M. E. Martin. 1500 w. Mfrs' Rec—May 2, 1918. Information concerning recent developments.

Oil in Southern Tamaulipas, Mexico (86414 D). Ezequiel Ordoñez. Map. 2800 w. A I M E, Bul—May, 1918. Oil possibilities discussed.

The Kentucky Oil Fields (85967). W. N. Thayer. Map. 3500 w. Eng & Min Jl—April 27, 1918. Oils are of a paraffin base and are marketed in two grades.

Oil Shale

The Oil-Shale Industry (86239 A). Arthur J. Hoskin. Ills. 5000 w. West Eng—May, 1918. Varieties of shale, methods of distillation, prospective development, etc.

Commercial Aspects of the Shale-Oil Industry (86079). J. H. G. Wolf. 1800 w. Min & Sci Pr—May 4, 1918. Deficiency of domestic oil production; necessary to consider the shale-oil problem.

Oil Storage

Oil-Storage Tanks and Reservoirs (86138 A). C. P. Bowie. Ills. 70 pp. U S Bur Mines—Bul 155. With brief discussion of losses of oil in storage and methods of prevention.

Oil Wells

A Concrete Example of the Use of Well Logs (86412 D). Mowry Bates. Maps. 1600 w. A I M E, Bul—May 1, 1918. Practical application of engineering geology showing the advantage of keeping accurate records of all wells.

Petroleum

The Petroleum Industry in Kansas (86069). W. A. Whitaker, Clarence Estes, and F. W. Campbell. Ills. 3000 w. Eng & Min Jl—May 4, 1918. Reviews the history of development, production statistics, costs, etc.

The Work of the Petroleum Geologist (86070). George E. Burton. 2500 w. Eng & Min Jl—May 4, 1918. Work in discovering oil and gas.

Toluol

Toluol from Spruce Turpentine (86,023 B). A. S. Wheeler. 1000 w. Jl Ind & Eng Chem—May, 1918. Yields toluol when subjected to the combined action of benzol aluminium chloride.

ORE DRESSING

Auxiliary Plant

The Granby Auxiliary Steam Plant at Anyox, B. C. (86544). Ills. 3500 w. Pr House—May, 1918. Serial, 1st part. The steam plant auxiliary of one of the largest smelters in British Columbia.

Concentration

Minerals Separation v. Butte & Superior (86554). 5000 w. Min & Sci Pr—May 25, 1918. Opinion U. S. Circuit Court of Appeals.

Dry Sizing as a Means of Preparing Feed for Concentration (86398). George V. Bland. 4000 w. Eng & Min Jl—May 18, 1918. Theory of the process is discussed.

Magnetic Concentration of Iron Ores at Mineville, N. Y. (86399). Earl C. Henry. Ills. 1200 w. Eng & Min Jl—May 18, 1918. Magnetite ores containing about 30% iron are treated magnetically.

Decantation Plant

A Description of the Decantation Plant in Operation at the Great Fingall Mine, Day Dawn (86376 N). W. B. Chomley. 2200 w. Cham Mines W Aust, Mthly Jl—Feb., 1918. Describes the plant and method of working.

Flotation

Differential Flotation of Lead and Zinc (85958). W. L. Zeigler. Ills. 1200 w. Eng & Min Jl—April 20, 1918. Practice in the Coeur d'Alene district.

Effect of Addition Agents in Flotation (86400). Ills. 1800 w. Eng & Min Jl—May 18, 1918. Sulphates and alums were added to the flotation pulp in a series of tests to determine their effect.

Flotation at Belmont Surf Inlet Mines (85954). A. H. Jones. Ills. 1500 w. Eng & Min Jl—April 20, 1918. After tests to determine proper flow sheet, a process was adopted involving gravity concentration followed by regrinding and flotation.

Flotation in Arizona (85953). Rodolf Gahl. 2500 w. Eng & Min Jl—April 20, 1918. Treatment of copper ores of the disseminated type. Review of recent developments.

Flotation in the Coeur d'Alenes (85952). Claude T. Rice. Ills. 7500 w. Eng & Min Jl—April 20, 1918. Reviews the process as applied to this district of Idaho. Details of method used for silver lead and lead-zinc ores as supplementary to gravity methods.

Flotation in Relation to Gangue Minerals (85957). James M. McClave. 1400 w. Eng & Min Jl—April 20, 1918. Field experiences in the application of the flotation process.

Flotation of Semi-Oxidized Silver Ore (85960). E. J. Atckison Flow sheet. 2000 w. Min & Sci Pr—April 27, 1918. The economics of methods in Mexico as compared with cyanidation.

Flotation vs. Cyanidation (85959). G. H. Clevenger. 3500 w. Eng & Min Jl—April 20, 1918. A comparison showing that cyanidation often has advantage in net returns.

Handling Flotation Concentrates at Utah Leasing Co.'s Plant (85955). H. H. Adams. Ills. 2000 w. Eng & Min Jl—April 20, 1918. Plant and operating details and difficulties encountered in handling cuperiferous tailings of low grade.

Troubles in Flotation (85956). Oliver C. Ralston. 3500 w. Eng & Min Jl—April 20, 1918. Review of the more important difficulties encountered.

Flow Sheets

Determining Flow Sheets in New Mills (85969). A. Schwarz. 1500 w. Eng & Min Jl—April 27, 1918. Importance of determining, before a mill is built, the method of concentration that will give the best results in dollars and cents.

Milling

Milling in Cyanide Solution (86299 A). A. W. Allen. 5000 w. Met & Chem Eng—May 15, 1918. A comparative analysis of the results of milling gold and silver ores in cyanide solution in place of alkaline water; and the relation of amalgamation in the selection of method.

Radium

Some Experiments on the Extraction of Radium from American Pitchblende Ores by Chlorination (85994 A). Mrs. Ray Cable and Herman Schlundt. 2500 w. Met & Chem Eng—May 1, 1918. Recovery was satisfactory for low, medium and high grade ores.

Sampling

Chart for Tonnage-Sampling and Dilution-Control (85961). Hallet R. Robbins. 500 w. Min & Sci Pr—April 27, 1918. Simplifying control of mill pulp dilution.

Smelting

Smelting Methods at El Paso (86,394). Courtenay De Kalb. Ills. 2500 w. Min & Sci Pr—May 18, 1918. Serial, 1st part. Receives copper and lead ores and concentrates from all over the south-west and northern Mexico.

PRECIOUS METALLURGY

Diamonds

See same heading under Geology.

Drift-Gravel

Drift-Gravel Mining in Eastern Siberia (86233). John Power Hutchins. Ills. 7 pp. Eng & Min Jl—May 11, 1918. Account of these deposits and the crude methods of mining, transportation, milling, and sluicing.

Gold

The Aroroy Gold-Mining District (86080). E. H. Clausen. Ills. & Map. 3000 w. Min & Sci Pr—May 4, 1918. Mines in the Philippines; character of ore, etc.

The Gold Industry and Gold Standard (86234). Hennen Jennings. 7 pp. Eng & Min Jl—May 11, 1918. Facts concerning production and the effect of present economic conditions on future output.

Gold Deposits

Further Studies on the Deposition of Gold in Nature (86261 B). Victor Lenher. Ills. 7000 w. Ec Geol—May, 1918. Experimental studies and results.

Gold Industry

The Gold Industry and Gold Standard (86533). Hennen Jennings. 6000 w. Can Min Jl—May 15, 1918. Review of the industry in the gold-producing countries and effect of present economic conditions.

The Gold Industry and the Gold Standard (86225). Hennen Jennings. Ills. 11 pp. Min & Sci Pr—May 11, 1918. Enormous increase in output; statistics; sources, cost, etc.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Administration

Activities of the Railroad Administration (86095). 2200 w. Ry Sig Engr—May, 1918. Chart and summary of orders issued and progress made.

Doings of the United States Railroad Administration (86321). 5500 w. Ry Age—May 17, 1918. Rate increases; proposed amalgamation of railroad associations; information for shippers.

Car Distributor

The Passenger Car Distributor and His War Job (86058). John W. Roberts. 1500 w. Ry Age—May 3, 1918. Important task of troop movements.

Delay

Delay in Train Movements (86103 A). Walter V. Turner. 1400 w. Ry & Loc Eng—May, 1918. Relation of various rates of retardation and acceleration to multiplication of initial delay in train movements into final or resultant delay.

Government Control

Italian Railways Under Government Management (86054). Map & Ills. 2500 w. Ry Age—May 3, 1918. Serial, 1st part. Value of unified direction exemplified as a war measure.

Halifax Disaster

Salvaging the Railway Facilities at Halifax, N. S. (86322). F. B. Tapley. Ills. 2200 w. Ry Age—May 17, 1918. Account of the damage done by the disaster of Dec., 1917, and the work of restoration.

Legislation

The Problem of the Short Line Railroads (86170). Sanford H. E. Freund. 3000 w. Ry Age—May 10, 1918. The intent of the legislation regarding their disposition and operation during federal control.

Signals

A. P. B. Light Signals on Union Traction of Indiana (86094). Ills. 2200 w. Ry Sig Engr—May, 1918. Details of a recently completed installation in Indiana.

The Interpretation of the Caution Signal (86097). F. H. Nicholson. Diagrams. 1500 w. Ry Sig Engr—May, 1918. Shows the relation between train-handling practice and the observance of the indication.

Terminals

Speeding Up the Operation of Terminals (86057). M. E. Burk. 2500 w. Ry Age—May 3, 1918. Suggestions for increasing the output of transportation.

Transport

Railways and the War Cabinet Report (86222 A). 2500 w. Engr—April 19, 1918. The accomplishments of over sea transport; railways, and their work; canals, etc.

Track Insulation

Some Tests on Fiber Used for Track Insulation (86096). G. Horatio Packwood, Jr. Ills. 2000 w. Ry Sig Engr—May, 1918. Specifications covering methods employed, with results and conclusions.

MOTIVE POWER AND EQUIPMENT

Air Brakes

Brake Conditions in General Freight Service and Their Relations to Shocks and Break-in-Twos (86253 N). H. F. Wood, with discussion. 36 pp. N E Rd Cb—Apr. 9, 1918. Air-brakes, their design, maintenance, care, etc.

Cars

Hopper Cars Built by E. J. & E. (86174 A). Ills. 1200 w. Ry Mech Engr—May, 1918. Side dump type without continuous center sill, floor members designed to take buffing stresses.

Standard Steel Sheathed Box Car (86175 A). 500 w. Ry Mech Engr—May, 1918. Specifications and designs similar to other box cars, wood lining on sides and ends.

Electrification

Electrification of the Chestnut Hill Suburban Branch of the Pennsylvania R. R. (86088). Map & Ills. 1500 w. Ry Rev—May 4, 1918. Details of construction and equipment from Philadelphia to Chestnut Hill.

Philadelphia—Chestnut Hill Electrification (86169). Ills. 2200 w. Ry Age—May 10, 1918. Latest improvements in catenary construction.

P. R. R. Extends Philadelphia Electrification to Chestnut Hill (85941). Ills. 2000 w. Elec Ry Jl—Apr. 27, 1918. Construction shows that overhead for single-phase railway lines is approaching standardization.

Equipment

Government Car and Locomotive Orders (86167). 2500 w. Ry Age—May 10, 1918. Distribution of orders with discussion of prices, specialties, and policies.

Car Constructon and Maintenance of Passenger and Freight Equipment (86251 A). D. D. Wilson, with discussion. Ills. 12 pp. S & S W Ry Cb, Pro—Jan., 1918.

Light Railways

Chemins De Fer A Voie Étroite (86471 B). G. Mangin. Ills. 2300 w. Genie Civil—Apr. 6, 1918. Locomotives and cars used on German and Austrian narrow gauge railways in the fighting zone.

Locomotive Performance

The Graphical Representation of Locomotive Performance (86247 A). H. Holcroft. 3000 w. Engr—Apr. 26, 1918. Serial, 1st part. Gives a method of plotting the speed curve with rapidity over any section of road for a given locomotive and train.

Locomotives

A Yankee's Idea of French Engines (86172 A). Ills. 1700 w. Ry Mech Engr—May, 1918. Describes the motive power and troubles in maintaining it.

Santa Fe Locomotive for the Belt Railway of Chicago (85965). Ills. 800 w. Ry Rev—Apr. 27, 1918. Heavy locomotive for hump yard work, although adaptable to transfer and road work.

Specifications of the United States Government Standard for Locomotives (86100 A). Also editorial. Ills. 4000 w. Ry & Loc Eng—May, 1918. Proposed standards.

Nuovi Locomotori Elettrici (86476 B). Ills. 1200 w. L'Industria—Mar. 15, 1918. Narrow gauge Alpine railway 38 miles long, and rising 5,900 ft. in 24 miles. Locomotive with four motors geared to countershafts and connecting rods for propulsion system.

Status of Standard Locomotives (86173 A). Ills. 1500 w. Ry Mech Engr—May, 1918. Probable extent to which they will be used; tentative general dimensions of proposed types.

Vierkuppler Rangierlokomotive der Schweiz-Bundesbahnen (86466 B). M. Weiss. Ills. 2000 w. Schweizerische Bauzeitung—Apr. 20, 1918. Switch engine, 0-8-0 type for Swiss federated railways.

M. C. B. Rules

Annual Report of the Standing Committee on Revision of M. C. B. Rules of Interchange (86252 A). 28 pp. Ry Cb Pitts, Pro—Mar. 22, 1918. Recommended changes with discussion.

Rail Return

Le Conducteur De Retour (86496 E). J. Lhériand. Ills. 20,000 w. Mem Soc Ingénieurs Civils De France—Oct.-Dec., 1917. Rail return for traction current on single-phase A. C. line, Midi Railway, France.

Ry. Fuel Assn.

Annual Convention of Railway Fuel Association (86525). 6500 w. Ry Age—May 24, 1918. Presidential address and papers by W. S. Carter, Frank McManamy, Robert Quayle, and E. H. DeGroot, Jr.

PERMANENT WAY AND BUILDINGS

Freight Station

New Freight Station of the New York Central Lines in Cleveland (86351). Ills. 2500 w. Ry Rev—May 18, 1918. Designed to permit freight handling by mechanical tractors.

Locomotive Works

At the Works of the Nathan Manufacturing Company, Flushing, Long Island, New York (86101 A). Ills. 1800 w. Ry & Loc Eng—May, 1918. Plan and description.

Maintenance

Review of Prospects for Railway Maintenance and Improvement Work in 1918 (86044). 2500 w. Eng News-Rec—May 2, 1918. Government restrictions may be relieved, but labor shortage is serious.

Passenger Stations

Safety Conditions in and About Passenger Stations (86354). 4000 w. Ry Rev—May 18, 1918. Serial, 1st part. From report of the Committee on Buildings of the Am. Ry. Eng. Assn.

Railway Extensions

Laying the Rails for Future Business (86050). Francis H. Sisson. 5000 w. Am Mach—May 2, 1918. Extracts from address by the vice-president of the Guaranty Trust Co. of New York before the annual meeting of the Chamber of Commerce of the United States.

Switch Yards

Power for Switch Yards (85985). Ills. 30000 w. Pwr Pt Eng—May 1, 1918. Hot water reclamation equipment and sand drying and transmission system features of new Clyde, Ill., yards of C. B. & Q. R. R.

Terminals

Two Large Railway Terminals Under Construction (86166). Ills. 2500 w. Ry Age—May 10, 1918. Novel features in yards being built by the Illinois Central and the New Haven.

Tie Tamper

"All in the Service" (86547 A). W. H. Armstrong. Ills. 2000 w. Ry Cb Pitts, Pro—Apr. 26, 1918. A mechanical device known as the Imperial Pneumatic Tie Tamper is described and results given.

Track Scales

Minnesota Track Scale Specifications and Tolerances (86053). Ills. 2500 w. Ry Age—May 3, 1918. Rules adopted by the state railroad and warehouse commission.

ROADS AND PROJECTS

France

Projet D'Une Deuxième Ligne De Chemin De Fer (86495 E). E. Evers. Ills. 4000 w. Mem Soc Ingénieurs Civils De France—Oct.-Dec., 1917. Project of a second railway from Havre to Paris, involving a tunnel under the Seine.

TRAFFIC

Freight

Train-Lot Plan of Moving Freight in West (86524). 2200 w. Ry Age—May 24, 1918. Operating economies by new method of handling traffic.

Package Freight

The Preparation and Handling of Package Freight (86055). A. C. Kenly. 1100 w. Ry Age—May 3, 1918. Illustrations from the diary of a freight inspector.

Increase in Rates in New England Allowed (86059). 5000 w. Ry Age—May 3, 1918. Financial condition reviewed. Higher rates and fares authorized.

STREET AND ELECTRIC RAILWAYS

Car Bodies

Steel Car Body Is Well Adapted to Resist Unusual Stresses (86331). Norman Litchfield. 3000 w. Elec Ry Jl—May 18, 1918. Form of mechanical structure which with minimum weight will give the required resistance to shock.

Freight

Electric Railways Are in a Position to Haul More Freight (86198). A. B. Cole. Ills. 30 pp. Elec Ry Jl—May 11, 1918. Shows how electric railways can relieve present traffic congestion.

Rhode Island Electric Freight Business Increases 185 Per Cent. in Ten Years (86543). Ills. 1500 w. Elec Ry Jl—May 25, 1918. Details of less-than-carload freight handling at Providence, R. I.

Railway Motors

Proper Analysis is Fundamental in Choosing Railway Motors (86329). C. W. Squier. 2500 w. Elec Ry Jl—May 18, 1918. Shows how speed-time graphs are constructed and describes considerations necessary for proper choice of car motors.

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Coal Conservation in New England*

Industrial New England is Solving a Grave Fuel Problem in Keeping with Her Genius for Home Rule

By Dr. Ira N. Hollis

New England needs 30,000,000 tons of steaming coal during the coming year and can get only 24,000,000 tons. How can the shortage be made up? Three ways are open: Eliminate non-essential industries; substitute other fuel, notably wood; conserve the fuel that can be obtained. It is estimated that fully one-fifth of all coal now used in manufacturing can be saved. This article outlines the Massachusetts plan and scheme of organization to reach every factory and reduce and eliminate the present wastage of fuels.

Dr. Ira N. Hollis *is Chairman of the Massachusetts Advisory Committee of Engineers for Fuel Conservation. He brings to this work a wide experience in public affairs and administrative responsibilities. Dr. Hollis is a graduate of the United States Naval Academy and served his country in the Navy for 15 years, resigning in 1893 to become Professor of Engineering at Harvard University. From 1913 to date he has been President of the Worcester Polytechnic Institute. During 1917 he was President of the American Society of Mechanical Engineers and during the same period was the leading organizer and first Chairman of the Engineering Council.*

IT is difficult to speak or write on any subject at the present time without some reference to the war. Many phrases have been coined and displayed on posters as calls to wake up the American people and yet most of these phrases have been entirely inadequate. There is serious danger in accepting as the whole truth a message that contains only a small part of the truth. For instance, it is said that "food will win the war." It will no more win the war than will a constant appeal to the Almighty for help unless we deserve the help by hard work. It is said that transportation will win the war, but transportation is as necessary in time of peace as it is in time of war. As a matter of fact, if transportation were to cease suddenly, the New England states would probably be half-starved before the year is out. They raise very much less than is necessary to support their population. In time of peace, but for transportation, whole regions of the earth would be depopulated. It is said that the farmer, the engineer, the mechanic, will win the war. All of these are just as necessary in peace as in war. They win for civilization and they do their share towards supporting our men overseas.

To say that food and munitions will win the war does not bring the matter before the American people in its most soul-stirring form. It is of our boys that we are thinking. To put them into the battle line, to give them all our strength and to bring as many of them back home after having won the war is the chief passion of the American people, and it is upon that plea that all appeals for the successful prosecution of this war must be based. No shibboleth amounts to anything except as it has a direct bearing upon the safety, welfare and success of our sons, whom we have sent to fight our battles in France. This is one of the thoughts that must come into any one's mind who proposes to talk about economy in the use of anything in America. They are like men in the diving suits and we are at the pumps. Our efforts and our saving of materials at home means all for them in the economy of lives and blood.

> **Nothing will win this war but the lives and blood of our sons, who are now standing on the edge of No Man's Land, between us and the destroyers of liberty. We must be economical of their lives and for that reason we must be economical of everything. We must permit no waste of anything that America produces in order that we may supply them. Only of our energy can we be extravagant, and even of that we must save the part now expended in foolish effort and vain shouting.**

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*Rewritten from address given in behalf of the Massachusetts Fuel Administrations.

Our Prosperity and Wastefulness

There is another thought. America has for generations enjoyed prosperity almost beyond imagination for a great population, because here was found undeveloped resources covering the entire continent. To some extent we had lost our heads before this war and had become the most wasteful nation on earth, almost like a swarm of locusts devouring everything before it and leaving nothing on which to begin future growth or development, or, like a herd of elephants that trample down more than they eat. It is only with recent years that we have come to an understanding of what exhausting the soil has meant to other countries and what it will mean to us, or exhausting the forests, or exhausting the mineral resources. All this is new to us because we have gone ahead with the thought that in boundless resources there is no necessity of frugality, and there is no call for saving any more than there would be in saving the waters of the sea.

The war has opened our eyes in more respects than one. We are learning this wastefulness through the withdrawal of many men and women from the useful occupations, through placing great numbers of our young men in the unproductive but saving industry of war. Peace will see the dawn of a new day because we shall have passed through these revealing years, which will tell us of our past sins and errors. When any one pictures before us the enormous resources in the coal beds of the United States and alongside of the picture the relatively minute portion of these resources that have been used, he is unintentionally encouraging the same kind of wastefulness that we have had in the past. It will take centuries to exhaust the coal and oil, so "why worry." An appeal to save in behalf of one's descendents, who are to come four or five hundred years from now, does not reach the average citizen. Who cares what his descendents may be, generations from now? Only the man who has a feeling for the race and for the enduring influence of the nation. It is difficult to project the family hope of making the sons and daughters better citizens with a capacity for greater service, into the long future of their descendents where every generation may climb one round higher in the scale of civilization and yet that is what we must do, if this war is to bring us anything in exchange for the sorrow and sacrifice it will entail.

Economy Has a Moral Basis

We speak of making the world safe for democracy. What is democracy except an instrument for promoting civilization and a nearer approach to that millenium that all of us hope may come some day to this earth. In wastefulness, we are holding back human progress, not only from the material point of view, but also from the moral point of view. In its last elements, all doctrine of economy rests on a moral and religious basis, because no man can be sound who has no reverence for the resources that the Almighty has placed at his disposal, and no man can be a good citizen who uses them to promote his own selfish aims and power. We are not robins passing through in the spring to devour the cherries without thought, but we are rational beings with will and mind to regulate our conduct in the interest of one another and in the interest of a better race.

This is the compelling thought in connection with any discussion of conservation, whether it be of food, of coal, or energy or of mental endowment. The subject should, therefore, be taken up as having a bearing, first, upon the success of our young men across the sea and, second, as having its vital effect upon the true influence of democracy upon the race after we have made it safe for the race. In this second aspect it is really the ten commandments that we are fighting for at the present time, or better still, the influence of the man who died on the cross. It is shocking to think of the false theories and brutal pride that have driven the Germans before the Furies into this war. The doctrine of hard materialism put forward by their professors in the "survival of the fittest" as the reason why nations do not have to respect the same moral code that individuals should observe, would bring a curse upon the earth.

The Coal Situation

The following is a statement of the Chamber of Commerce of the United States, authorized by Mr. J. D. A. Morrow, General Director of Distribution for the United States Fuel Administration.

First. We are not going to have enough coal next winter.

Second. The supply will be enough to keep the people warm and to run the nation on a war basis—no more. The Fuel Administration will see that coal is distributed to accomplish that result.

Third. The preferred list issued by the War Industries Board indicates the classes of consumers that it is of supreme importance to supply. They will get their coal. Other consumers will have to take what is left. Some of them will not get enough.

Fourth. The supply of coal for domestic consumption will be adequate in those communities that bestir themselves now and arrange to get their coal in early. Those that wait do so at their peril. Communities that take active measures toward building proper storage facilities for laying in coal will receive the full co-operation of the Fuel Administration in that work.

Fifth. Can we produce enough coal for all? Yes! But the railroads cannot haul all the coal demanded in some parts of the country, and at the same time haul all the things equally necessary, such as iron ore, steel, cotton, wool, lumber, food, guns, shells, ship plates, and the like. This condition will limit the output of coal, and the supply of it in some parts of the country, particularly on the North Atlantic seaboard. It is a problem, therefore, not of mine production, but of railway transportation.

Sixth. Because of the growing flood of war orders, the burden placed on the railroads is growing steadily.

The saving of coal is but one little corner of the picture put up before the American people. At the present time, it looms up as an immensely important corner to every section of the country, simply because we cannot get the coal. Our transportation system is in larger part absorbed in moving supplies and munitions. New England occupies a peculiar situation in relation to transportation and the procurement of supplies of all kinds. It has comparatively few natural resources outside of its forests and its water-power. It is off in a remote corner of our continent. It would probably never have developed into anything beyond a hunting ground, if America had been discovered on the western coast with all the fruitful lands of the Pacific to make a prosperous race. On the other hand, America would have been poorer without the strong character developed under the hard conditions of this climate and this soil. One of the greatest difficulties in regulating the coal business for the country is to make men from west of the Hudson really understand the peculiar conditions under which this region must always do its work. We shall have a shortage in the coming year as stated, probably not less than 6,000,000 tons of steaming coal. It is not necessary to go into the subject of anthracite for the homes, because the supply has in a considerable part been provided. To be sure it is only two-thirds of the amount allowed last year, but we can probably worry through by supplementing with wood and by clothing ourselves a little more warmly.

Learn to Save Coal for Future as Well as Present

There is no need of great accuracy in regard to the amount of the shortage. Whatever it is, it will mean a serious matter if any of our industries are compelled to shut down. Furthermore, whether there is a shortage or not, we ought to conserve coal, both for the future supply and for the saving in money that will be effected. Heretofore the cost of coal has been a relatively small part of the cost of the manufactured product, in some cases, not even one per cent.; consequently, attention has not been directed to it as to other elements of total cost. It is just as well for us to learn now, whether there is to be a shortage or not, how to save the small percentages in our manufactures in order that this country may be in a position to hold its own in the keen competition that is certain to follow this war. It is therefore not necessary to debate or even to discuss the total shortage for New England, or for any other section, because every possible saving ought to be effected any way. In case of serious shortage, of which we have unhappy prophecy in what has happened to our supply during the past three or four months, many places that are not essential to the conduct of war will have to be shut down and many people will be thrown out of employment. That will produce a period of serious unrest and interference with the conduct of the war. We cannot contemplate this condition without being impelled into some action that will safeguard us.

What are we going to do about it? What are the manufacturers going to do about this for their sons on the other side, for their children and families on this side, and for their section of the country, and finally for their race? It is a high duty that is before them, not simply an appeal to the self-interest of any individual but a strict obligation upon them as members of a Christian nation trying to make this world safe for democracy, trying to save the remnants of the ten commandments and trying to take care of young men whose bodies are between all of us and the Huns. No man can go to church with a conscience or can go home with a conscience who has neglected his opportunities to serve the nation by saving. No operative in any mill can be allowed to forget his contribution. It is a matter for us all, in the factory from the youngest apprentice to the president, and in every building from the janitor to the most casual occupant.

How to Reduce Coal Requirements

What are the methods of reducing the requirement of coal? If we need 30,000,000 and can get only 24,000,000 tons, what will be the method of living within that twenty-four millions? There are three methods of reducing the amount of coal needed. Coal is referred to principally because it is the fuel chiefly used and it is the serious problem in New England.

1. *By elimination.* That is shutting down industries not absolutely necessary for the conduct of the war and closing off light, heat and power in all departments where they do not contribute to the necessities connected with war.

The second of these may be dismissed at once by the statement that the process of elimination to be found in cutting off city lights, advertisement signs and unnecessary display has not gone far enough. Attention will ultimately be directed to it through the Fuel Administration. In the meantime the fuel committees throughout the states have not insisted on eliminating waste of this kind, and it is waste when we need the coal for important industries.

The first will involve hardship to a great many people. Whenever any factory is shut down because it is not doing war work, many workmen will be thrown out of employment and their families will suffer. They will not only not have the coal at home, they will not have the money to buy food and coal, and riot will be the inevitable consequence. The process of elimination for industries is made more difficult by the impractibility of drawing a clear line between non-essentials and essentials. We have to live while we are carrying on war and so far as possible the orderly, normal life of this people should continue without interruption. Any one who tries to write down a list of the non-essential industries will find himself involved in a tangle of inconsistencies. Even the greenhouse, which has been deprived of fuel, and wisely, has a function in everyday life by providing for the household at least an element of cheerfulness. The method of elimination will promote the period of unrest and we hope it may not be found necessary. It certainly will be unless the manufacturers of all states, even those who have priority from Washington, join in a generous campaign to cut down the amount of coal needed. The war industries must help the peace industries. This again is a great question of coöperation amongst those who are left at home to keep those who have gone well supplied. We must all work together. New England has never been found wanting in this respect and even the important war manufacturers will be found public-spirited in their efforts to cut down the consumption of coal so that no industry, however modest, may be deprived of its coal supply and so that no workmen may be thrown out of employment.

2. *By substitutes.* A second method of reducing the amount of coal needed in all parts of the country is by the use of wood and oil, and by the extension of water power. We should cut plenty of wood and have it in storage now. Every fuel committee in the state ought to have its wood committee who will see to it that a sufficient supply is cut and stored as an insurance against shutting down any factory next winter. Several sections of Massachusetts are doing something in this direction, but not nearly enough. While it is futile to reckon in definite figures, it is probable that one million cords of dry wood can be used in each one of the populous states this year to great advantage. Wood cut next winter will be so green that it will be far less efficient in producing steam for the factories and heat for the families than wood cut now and partially dried during the summer and fall. Consequently this is imperative now, not some time in the future. We have such a tendency in America to let things slide along, feeling that we are going to muddle through, that we do not make plans ahead. That is where Germany has the jump on us, and we cannot get a running start. It is not the misfortune of our own country that we have failed, but rather that we have not looked into the future. It is the better part of prudence to see to it that we are provided by rational systematic methods than to wait in the hope of getting along somehow. We have been too content to muddle along in Washington with our political and business affairs and we are now paying extravagantly. Is Massachusetts going to wait for a grave crisis before taking steps to keep the industries going next winter? A shortage of 6,000,000 tons is a bad matter and we ought to take advantage of everything that will help us along. One million cords of wood, fairly dry, would probably be equivalent to more than half a million tons of coal, which is something.

The supply of fuel oil is too small to affect the economic conditions of New England very much and we must turn to the other substitute in the hope of accomplishing something by a closer study of water-power management. There is not time to develop new water powers in any part of New England before cold weather, but we can probably make the available water power more widely useful. Every hydro-electric plant and every purchaser of electricity ought to be saving so that the small steam plants may be replaced by electric power. At present the electric plants are oversubscribed and the wider use can be accomplished only by saving on the part of the large users. This substitute becomes more available by shutting off all unnecessary power and lights. The best we can do, however, is only a fraction of what can be accomplished by attention to the use of coal itself.

3. *By conservation.* How can our share of 6,000,000 tons be saved? Only by the elimination of waste on the part of coal users and that again depends upon coöperation among the workmen in every factory and among the factories in relation to one another. We have heretofore been satisfied because the fuel cost has represented so small a part of the manufacturing cost, but no plant is free from serious waste at the present time. Even those factories and mills and power stations that have directed attention to economy are still far from being as efficient as they can be made and as they will be in the future. The cost of a kilowatt in an electric plant has gone down from four or five pounds of coal to less than two in reasonably efficient plants by long and careful attention. While every effort has been directed to increased efficiency in the production of steam and in the development of power and, while more can be accomplished in both, engineers have not striven to bring the use of power and its expenditure for lights up to maximum economy.

Massachusetts' Organization to Reduce Fuel Waste

What is, then, the obvious method of reducing waste? It is by calling attention to it through administrators or committees appointed for that purpose in every factory, power station and building, whether under private or city management. This is undertaking the problem by voluntary organization within rather than by pressure from without and is urged by the Fuel Administration of New England, particularly through a committee for the State of Massachusetts.

There has been a slight confusion in connection with the appointment of a factory fuel committee. The term is not descriptive enough, as a conservation committee is meant, having relation to all the use of light, heat and power in any manufacturing or power establishment. The place of a factory committee, which should be made up entirely of employees, is wholly within the property on which coal and power are used. It is made responsible only to the management and has no connection with the state or with the United States authorities. The organization in Massachusetts as a whole is as follows:

1. The fuel administration, having offices in the State House in Boston.
2. An advisory committee of engineers for conservation.
3. Local fuel committees appointed for every city and town.
4. Advisory committee appointed by the local fuel committees in every city and town. One of these is for wood and one for conservation, made up of the best men obtainable having knowledge of the subjects.

Pledge cards are sent out asking every company throughout the state to pledge itself to save coal by appointing a factory fuel and power committee to look after the expenditure of coal in the fire-room and the proper use of heat, light and power in the property coming under their jurisdiction. Such committees have already been appointed in some places with a resulting gain. Every factory, every power station and every business building must be treated as a whole and should have its committee. Here is where the coöperation brought about by forming a committee consisting of representatives from all departments may be most effective. Every individual in a factory ought to be encouraged to feel that it is his personal contribution towards success in the war to help in reducing the coal used. It is confidently asserted through factory fuel committees giving their attention to all details of manufacture that fully 20 per cent. can be saved.

Our Battleships Teach Coöperation

The best illustration as to the possibility of coöperation may be found on our battleships, where every man has to learn that he is an essential factor in winning a battle if the ship is to contribute her effective share in war. This story is related of the *Oregon* after her long voyage from California through the Straits of Magellan to the coast of Florida. She was ready for Santiago the day after her arrival and was sent to the blockade. In the battle that followed it was her 13-inch gun from the forward turret that sent the *Colon* ashore and ended in the great victory of the American fleet over the Spaniards. This gun was fired at the request of the chief engineer who wanted to hearten up his men below the protective deck, the men who were doing their work under none of the glamor of warfare in the open, where they could see the shots fall and the enemy's ships destroyed. It was simply the prosaic shovelling of coal in the full knowledge that they were in the hands of other men on the deck of the ship. The exact message that was carried to Captain Clark has been reported in different words, but in every case it has contained the statement that a gun fired would cheer the men below and would give ten pounds more steam in the boilers. One of the engineers listening at the speaking tube when this gun went off, and the noise and the shock penetrated to the after-fire room, heard a shovel scrape along the floor plates and the coal go into the furnace. He heard, too, a fireman say as he threw the coal "There, take that, you dirty Dago." It was his shot at the Spaniard. It was his share in the great battle. Not only a worthy share, but one taken in the unspectacular conditions of a dark hole below a heavy protective deck.

This is the spirit which should actuate every man who has a shovel in his hand or is running a machine in the mill. It is his share toward winning this war. Every shovel of coal, if usefully expended in the furnace, will do something to save us a life on the other side and every shovel of coal that is wasted by careless firing or by the careless expenditure of power, will do its share in losing us one of our boys in France.

Again, attention to this detail was so typical of the officers on the *Oregon*. The chief engineer spent a large part of his time wandering around to see that distilled water was not wasted on the voyage, so that his boilers might be kept free from scale and ready at all times. The shutting off of a single lamp, the saving of a few tons of coal or of a few heat units is a contribution. There are upwards of 5,000 factories in the State of Massachusetts, and if one single lamp were closed off in every one of them it would mean a saving of 900 tons of coal in the course of the year.

Suggestions of Advisory Engineering Committee

The Advisory Engineering Committee for the state will send to every fuel committee enough copies of a circular informing managers in a general way where to look for waste. Many of them know already and this circular is only a starting point. Inasmuch as it is intended as general advice for all factories and buildings, it may not exactly fit every power user, but it will be helpful in the main and can be modified to fit every case. The committee has suggested the form of organization. This is taken from one of the large companies and is already in practical use, but it is much larger than will be necessary in many companies. It, therefore, forms but the skeleton from which the plan of organization may be taken. It makes no difference whether the committee be large or small, so long as it is representative and so long as it takes into consideration all the departments in a factory or building. One man in a small company is sufficient and a small number of men will answer well in any company if they are sufficiently conversant with all the details of power use. The main thing, after all, is to have attention called to the losses and to the preventable waste. Under all circumstances it is advisable to have a regular meeting of those who have been selected to supervise economy, in order to report results and if possible to let the workmen know all cases of improvement. The member of the committee who puts down statistically all that has been done, both to promote saving and to record results, may be designated as the secretary or the administrator. Attention must be called to the fact that this is not confined to the combustion of coal in the boilers, but goes all the way through the factory from the coal in the yard to the finished product when it leaves in the cars.

In New England it is particularly hard to get men to sign pledge cards. The individual would prefer to do what is expected from a motive of conscience rather than to preach about what he is going to do, but the pledge cards if brought together in the State House at Boston will form an evidence of how successful the Fuel Administration has been in reaching all coal and power users.

In order to do this work well and with no cross purposes, the coal fuel committee of each town should consider itself responsible for promoting economy. These fuel committees began with fixing prices, then they took a hand in the distribtution of coal and now they must contribute their best efforts toward its conservation.

Save Coal in Same Spirit That You Save Food

A great deal of literature has been issued by the national government and by the state, some of it good and some of it ineffective. We have all grown stale on circulars, but this case is one that should arouse the interest of every individual in the state. The splendid work of the Food Administration in enlisting the interest of every person in the country toward saving in order to supply our men and our Allies across the sea should be an example to us. This is the end aimed at by the fuel committees, without any more literature excepting that which is absolutely necessary to assist coal users in a more intelligent study of the losses in their factories and in their buildings.

Save Heat and Power For Work

Saving is a matter of common sense. A very little book-knowledge is required by the factory committees, which may be made up of practical men. One of the first things to begin on is the method of heating all rooms and the use of exhaust steam for that purpose. Generally too much heat is put into our factories. Windows thrown open and elevators operated without doing any work represent an outlay in fuel and in labor for which there is no return. There is a great loss of power in the machine shops and in the running of machinery of all kinds. This is so important that steam heat is hardly needed in a great many rooms where the friction losess turned into heat are sufficient to keep the workmen comfortable. Shafting out of line is an excessive loss.

The circular sent out by the committee to manufacturers through the fuel committees will contain suggestions of forms for keeping a record in some of the departments. These too will be useful, especially in putting down the exact amount of fuel burned from time to time and the reasons why there is a gain or loss.

The local fuel committees should have their advisory committee made up of manufacturers and engineers to disseminate information and to inspect plants for the purpose of suggesting improvements toward reducing waste. This does not mean that any advisory committee should take the responsibility for rebuilding a factory or expending a large outlay towards improvement —that ought to be done by a consulting engineer regularly employed for the purpose—but it does mean that every one who has a good practical knowledge of power development and manufacture should be willing to suggest methods of improvement. The committee of engineers for the fuel administrator will be glad to assist in this way and will, if requested, provide at least first-aid in carrying out the plan to save coal. Engineers have volunteered to visit plants and each community can by dividing the inspection amongst manufacturers, accomplish a great deal. If the coal using places are divided into groups of ten, with one competent person to look at them, say once a month this summer and fall, all the work can be carried out without inflicting a serious burden on any one.

Federal Plan of Administrative Engineers

Massachusetts began this system of saving before the Federal Government had gotten around to it and its plan differs slightly from that of the Administration in Washington, but after all what we are after is fuel saving and effective coöperation toward carrying on the war and not in perpetuating some special plan of organization. The system suggested by the Government is the appointment of a fuel administrative engineer for each state, whose functions shall be to inspect or cause to be inspected every coal-using establishment excepting the homes and to rate each one according to its efficiency. This can be done in Massachusetts very easily after the factory fuel committees are formed and the manufacturers themselves get to work. The distribution of coal should naturally favor those who are saving so that if the shortage becomes too serious to carry on all the work the least efficient plants should be cut off first. The federal oversight, by means of outside inspectors, may be necessary in the end, and it may become so natural a part of the method now followed in Massachusetts that we shall all be glad to have it. The genius of New England is, however, home rule and the individuals can probably do for themselves by attention to details all that is necessary to enable us to get along with the available supply

Managing Non-Repetitive Work

How to Set Times on Lathe Work in Tool Making

By Norman Howard

Taking a large stud as an example the author shows in detail how to estimate the time for every operation necessary to make it on the lathe. The same methods apply to work done on machine tools other than the lathe, and to repair work as well as to tool making. An idea of the expense of making such pre-estimates of producing times is given from the fact that a skilled task setter can figure 10 to 15 jobs in an 8-hour day.

Mr. Norman Howard after preparing for college entered an apprenticeship in the machine shops of the National Conduit and Cable Company. After finishing his time he stayed with that firm, advancing to the position of foreman. During the past five years he has held positions from foreman to factory superintendent in several important machinery-building and munitions plants. Recently he has been engaged in improving shop organization and methods and is now in the employ of the Emergency Fleet Corporation

A PREVIOUS article beginning on page 55 of the July issue gives a classification of the unit operations of machine-shop jobs commonly found in tool making and repair work. The operations of grinding, die-making and specialized tool-room work were omitted, as they belong in a special tool making classification in which they can be readily standardized, although there are many separate items involved. This article is devoted to the methods employed in pre-determining production times on non-repetitive work. The example taken is a large steel stud and all of the machining operations are confined to the lathe.

Figure 1 gives the procedure for task setting on this piece. The stud is seen to have a body diameter of 7 inches, a straight shoulder with a diameter of 5 inches and a 3-inch threaded shank. The total length is 20 inches. The thread to be cut is a 60 degree V, 3½ threads per inch. In addition to a view of this piece, Figure 1 gives the instruction card for its making with a total allowed time of 4 hours and 36 minutes. This illustration also gives portions of the various operation sheets on which are given the unit times that go to make up the total time for the entire job. To permit the showing of each unit time allowance in its proper location on a single magazine page, the material is somewhat condensed. A glance at what is presented will show that there is a time allowed for every operation that the mechanic will perform including a fair allowance for cleaning the machine and for personnel needs. Figure 2 shows a complete instruction card form such as is used for the machining operations.

To show in greater detail just how the times are set, let us take up a few of the standard operation sheets in detail. Figure 3 shows the complete sheet for outside lathe turning as used by the task setter, the surface speed for each of three different grades of steel, the number of revolutions per minute for each diameter from 1 to 12 inches, inclusive, the depth of cut and feed per revolution are all given. Also for each diameter the time is given to machine a piece of metal 1 inch long at the prescribed feed, speed and depth of cut. It is easily seen that with the above conditions standardized the time to finish the job is equal to the number of cuts times the length of each cut, times the standard time required to machine a section 1-inch long at each diameter.

In the average case we allow two additional finishing cuts beside the roughing cuts.

After having calculated these unit times in advance and set them down in the manner shown, the task setter is able to complete the setting of a large number of tasks in a comparatively short space of time. This work must be done expeditiously if the cost of estimating is to be kept within reasonable limits. Turning back to Figure 3, the sheet for rough turning the outside diameter, it will be noticed that the basic surface speeds are the Taylor outside diameter turning speeds for a ½-inch, high-speed steel tool with coolant. The conditions thus set up are known by experiment to be the best for the lathes classified under group 3 in the preceding article in the July issue.

Time Required for Estimating

From the numerous problems worked out on the sheet of Figure 3, its computation may appear to be a large job, especially when one considers that many other sheets must be prepared to set up a complete set of standards. But the time required is not excessive, for with a proper set of graphs each problem can be solved in about 30 seconds. Each problem is comparatively easy of mathematical determination once the proper surface speed, cut and feed have been decided upon. More difficulty is experienced in connection with the operations involving a time study of the human operations such as are classed in the C. L. and H. L. groups.

In this connection it is well to advise any one who plans to work out such operations to establish first standardized mechanical conditions before attempting to apply standard times.

Manipulating Lathe Carriage and Cross Compound Rest

Closely related to the operation of outside turning is a proper allowance for manipulating the lathe carriage and the cross compound rest. A table, omitted here for lack of space gives the time allowance for this operation. The left-hand column gives the length of cut, ranging from two inches up to six feet. At the top of each of the other columns is indicated the number of cuts. Each one of these columns is double, and in this way two different times are given. The shorter is for the lighter and more flexible lathes, while the other is for the heavier machines. When figuring the number of cuts on outside diameter turning the task setter can jot down the manipulation time allowance from this sheet.

The times given in the table are founded on an actual time study of working conditions and are not too low. The motions of removing the tool from the work and later advancing the tool toward the work are constant, while the later motion of moving

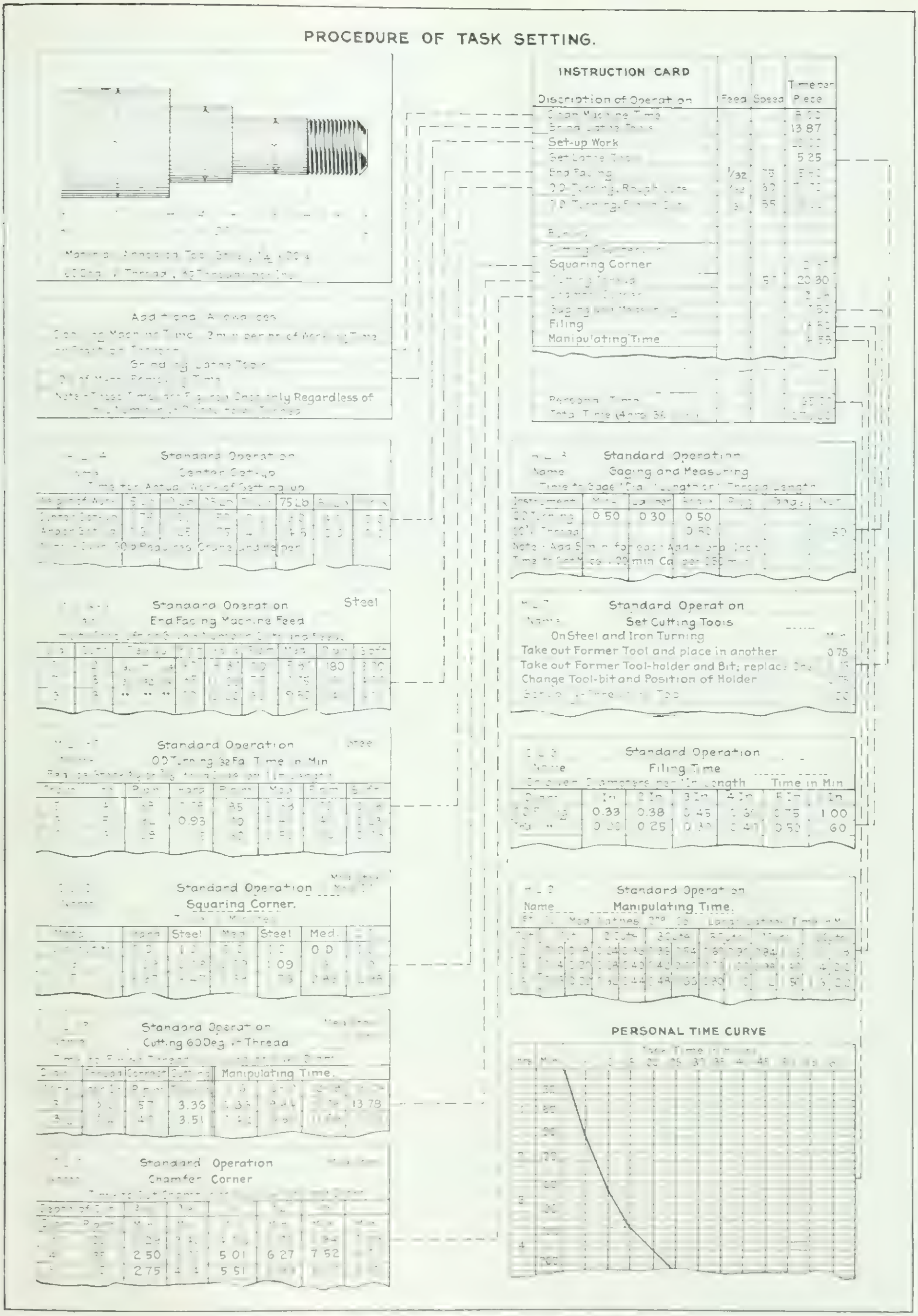


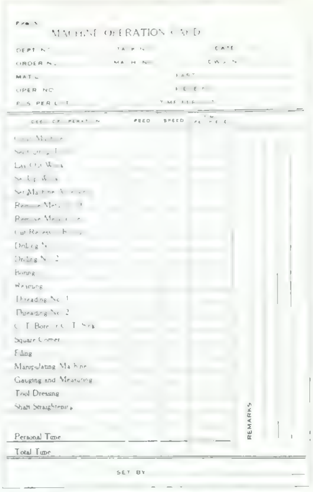
FIG. 1. [illegible] FOR TASK SETTING ON A LARGE STEEL STUD

the lathe carriage the length of the cut from the finishing of one cut to the beginning of the next, is a variable change from the length of the cut itself. Each motion entering into this table was studied and timed separately, the same constants being added to a different variable with each different length of cut.

SET-UP TIME

Let us now consider the set-up time. This is also a H. L. operation classified as "center set-up

(H. L.1). The repair set-up time is arranged on the same sheet for convenience, (not shown here). Here are classified the set-up times according to the weight of the job, including the weight of the dog. The times given allow for taking one piece off centers, removing the dog, placing the dog on a new piece and placing the new piece on centers; or, in other words, a complete cycle of the setting-up and taking-down operation. At the bottom of the sheet is a table of weights of steel of various dimensions from which the task setter can estimate at a glance the approximate weight of the piece he is considering.



MACHINE OPERATION CARD

DEPT NO

ORDER NO

MAT'L

OPER NO

PART

DATE

FEED

SPEED

Lay Out Work

Set Up Work

Drilling No. 1

Drilling No. 2

Boring

Reaming

Threading No. 1

Threading No. 2

C. T. Bore or C. T. Sink

Square Corner

Filing

Manipulating Machine

Gauging and Measuring

Tool Dressing

Shaft Straightening

Personal Time

Total Time

REMARKS

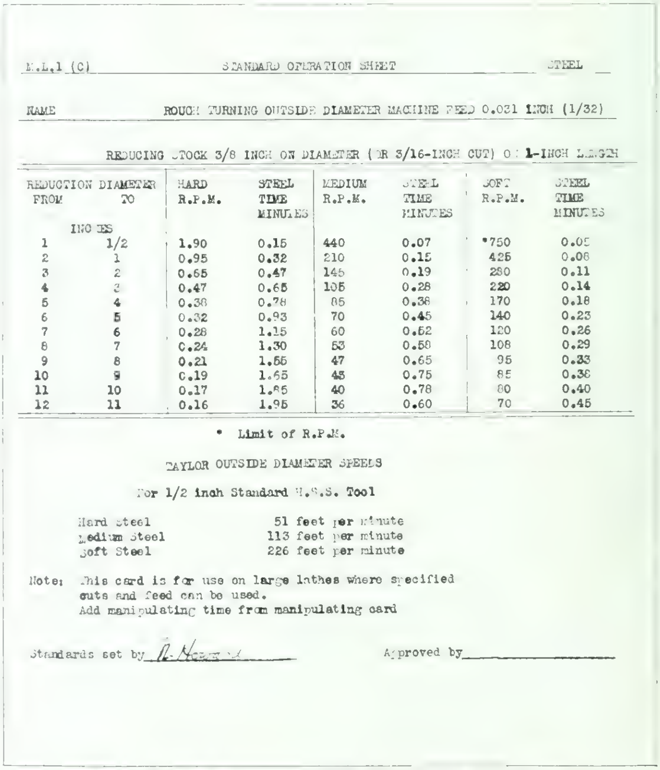
SET BY

FIG. 2. INSTRUCTION CARD

To obtain the standard time for setting up, he must judge the number of times the piece must be set up and multiplied by the unit time. It is evident that the task setter computes the time to complete one piece, and if there are, say, 40 pieces on the order, he simply multiplies the total task time of one piece by 40 to get the time for the lot.

OTHER OPERATIONS

The various other times used in connection with the task of Figure 1, such as the time for squaring the corner (C.L.10) cutting a chamfer or countersinking (C.L.7), filing on a lathe (C.L.6), gaging and measuring (H.L.3) and setting cutting tools (H.L.7) are founded on averages taken from time studies that would no doubt be of interest and value if there were space to present them. At first thought it may seem impractical to determine and standardize how many times a man should use his micrometers or calipers on a turning job. But we have found it perfectly practical to do this and have limited the number of times a man should use his measuring tools on roughing operations, making allowance also for the time necessary to set micrometers or calipers and also the time necessary to use them on each diameter and length. As a matter of fact, it is easy for a man to get into bad habits in measuring work and waste a lot of time. The ordinary system of management has no control in such cases.



M.L.1 (C) STANDARD OPERATION SHEET STEEL

NAME ROUGH TURNING OUTSIDE DIAMETER MACHINE FEED 0.031 INCH (1/32)

REDUCING STOCK 3/8 INCH ON DIAMETER (OR 3/16-INCH CUT) ON 1-INCH LENGTH

REDUCTION DIAMETER FROM	TO	HARD R.P.M.	STEEL TIME MINUTES	MEDIUM R.P.M.	STEEL TIME MINUTES	SOFT R.P.M.	STEEL TIME MINUTES
INCHES							
1	1/2	1.90	0.15	440	0.07	*750	0.05
2	1	0.95	0.32	210	0.15	425	0.08
3	2	0.65	0.47	145	0.19	280	0.11
4	3	0.47	0.65	105	0.28	220	0.14
5	4	0.38	0.78	85	0.38	170	0.18
6	5	0.32	0.93	70	0.45	140	0.23
7	6	0.28	1.15	60	0.52	120	0.26
8	7	0.24	1.30	53	0.58	108	0.29
9	8	0.21	1.55	47	0.65	95	0.33
10	9	0.19	1.65	45	0.75	85	0.38
11	10	0.17	1.85	40	0.78	80	0.40
12	11	0.16	1.95	36	0.60	70	0.45

* Limit of R.P.M.

TAYLOR OUTSIDE DIAMETER SPEEDS

For 1/2 inch Standard H.S.S. Tool

Hard Steel	51 feet per minute
Medium Steel	113 feet per minute
Soft Steel	226 feet per minute

Note: This card is for use on large lathes where specified
cuts and feed can be used.
Add manipulating time from manipulating card

Standards set by ____________ Approved by ____________

FIG. 3. STANDARD OPERATION SHEET FOR OUTSIDE LATHE TURNING

Perhaps the most difficult operations to standardize were those of end-facing and thread cutting (M.L.4 and C.L.12). The former is an involved operation because the manipulating time is included with the cutting time, and on the larger diameters where a great amount of metal is to be removed many cuts are necessitated with changes of feed and speed. So the sheet for this operation is based on time studies of actual jobs rather than upon computations from department feeds and speeds.

THE OPERATION OF THREAD CUTTING

The thread cutting times (C. L. 12), is perhaps the nearest to scientific standard of any we have standardized. The sheet is laid out so that this schedule is composed of the cutting time at the left and the manipulaing time at the right. The latter is worked out along the same lines as the schedule for outside diameter manipulating time allowances, but in the former the manipulating time for one return of the tool from the finishing of the cut to the start of the next cut is simplified by the total number of cuts or tool passes. The times given are the total manipulating time allowed for cutting a thread of the given size and length. The actual cutting time is added to the manipulating time to get the total thread cutting time. The cutting time is worked out for the number of cuts or pieces required for the tool to reach the bottom of the finished thread, which number was determined by a time study on different sizes of threads. The cutting speed is taken from the data on Dr. Frederick W. Taylor.

Transportation by Power Trucks

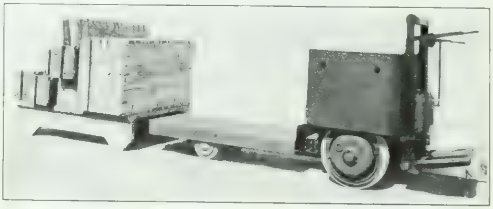
How the Intensive Demands of Industry Have Developed Means for Mechanical Handling of Materials

By Reginald Trautschold

The demands of war production have stimulated the development and use of the power operated factory truck. Various needs have contributed to developing standard types and "specials." Features of a number of types of this class of equipment are given in this article, together with several helpful paragraphs dealing with operating costs.

Mr. Reginald Trautschold *has specialized in power plant design, machine design and factory economies. From 1898 to 1911 he held positions of designer, superintendent of construction, chief engineer and sales manager with large manufacturing firms, including Sprague Electric Co., Marine Engine and Machine Co., Henry R. Worthington, Arnold Sewing Machine Co., Robins Conveying Belt Co., and the Intercontinental Engineering Co. He now practices as a consulting engineer.*

DISTRIBUTING A MISCELLANEOUS CARGO WITH INDUSTRIAL TRUCKS
C. W. Hunt Co., New York



ELEVATING TRUCK READY TO TAKE ON A LOADED CRADLE
C. W. Hunt Co., New York.

IN no field has the intensive activity in the industries necessitated and brought about by the present demands upon our resources, our products and our manufacturing skill been productive of greater innovations and developments than in the field of mechanical handling of materials. The progress made toward efficiency and in more effective means of transporting every kind and form of product has been truly remarkable. To be sure, the exigencies of the time have made such developments necessary—the need of ever greater production, the scarcity of labor and its increased value, the betterment in shop and factory conditions demanded for the more effective conduct of industrial pursuits, the health of our workers and the economic reasons have, one and all combined to bring about the change. The progress was inevitable, but the critical world condition has materially accelerated it, and there is no question but that one direct effect of the war has been to bridge an extended period of evolution in the art of handling materials.

The progress has by no means been limited to that made in equipment for handling great loads—powerful cranes, traveling bridges, etc.—nor to the many conveyors and carriers confined to fixed lines of travel, but is even more marked in the extended employment of power trucks to replace hand propelled equipment and to eliminate much of the manual work considered unavoidable but a few years ago. The highly effective power trucks now employed have not all been developed since the outbreak of the war, it is true, but their wider use has been largely brought about by war conditions. The question of production has overshadowed that of economy, but the result has been remarkable economic betterment, although in many instances it has been a question of output irrespective of cost. This subjugation of the investment has been operating and maintenance expenses, by the consideration of speed, has made possible many installations of relatively costly handling equipment which under normal conditions would not have been made until the economic value and wisdom of the installation had been proved to the satisfaction of the cautious and, not infrequently, over conservative shop.

These enforced investments have been productive of quite as marked economies as in gains in speed and capacity of transportation, it is safe to say, although any accurate comparative statement of operating costs can not well be presented. For instance, in a certain large wire plant, bulky and heavy loads of "copper cabbages" are now piled on the platform of a storage battery truck and a load of a couple of tons transported about the plant at a speed of about four miles an hour. The consumption of power is 1¼ kilowatts per hour and the truck is in charge of one man. To accomplish the same work by hand propelled trucks without imposing too arduous a task on the attendants, half a dozen trucks with as many operators would be required. The economy of the power truck is unquestionable, despite the fact that the initial cost of the highly developed storage battery equipment exceeds the combined cost of hand trucks which could be employed for the same task. A more highly skilled attendant is required for the electric truck than for handling the manually propelled equipment, commanding a correspondingly higher rate of pay, but even in these days of high recompense, the wages of the one skilled operator will not be equal the aggregate of the wages paid the less skilled in pre-war times. Furthermore, the more numerous employees of lower earning power could not be secured during the present scarcity of labor, and it is questionable whether the supply of such unskilled help will again be as plentiful as before the war.

PAIR OF INDUSTRIAL TRUCKS SWITCHING LOADED FLAT CAR
C. W. Hunt Co., New York

The raising of the plane of work heretofore discharged by unskilled labor is another of the more important effects for which war conditions are responsible. The less skilled classes of labor have been trained to operate and become familiar with automatic and semi-automatic equipment. The scarcity of labor has resulted in workers of all classes becoming more effective, and the training which this has necessitated has been productive of an elevation in the demands and expectations on the part of labor.

The day of back breaking effort and exhaustive manual exertion has been relegated to the past. Labor will demand every mechanical aid to lighten work and expedite production, and intensive production will make the adoption of such devices essential. In this connection, the more extended use of power trucks will play no inconspicuous part.

Storage Battery Trucks

The advent of the electric storage battery truck really antedates the outbreak of the world war by a few years, and was brought about by the demand for an economic and speedy vehicle for handling baggage at large railway terminals. The Pennsylvania Railroad seems to have been a pioneer in the movement, for at their New York terminal was introduced the first commercial application of the storage battery truck. The service called for a mobile power truck suitable for moving expeditiously in cramped places and congested quarters, forward or backward, and capable of negotiating relatively steep grades. Similar requirements are to be found on steamship piers, in freight sheds and warehouses and about factories and mills where the storage battery truck has now become a necessary adjunct and one of remarkable economic value. For handling diverse lines of merchandise, manufactured products of all descriptions, textile materials, boxed goods, steel rails, bags of meal, ingots and metal pigs, kegs, barrels, raw materials and products in the process of construction—in fact, anything which can be piled on the platform or into the body of an industrial truck—can be handled most effectively and economically by the adaptable storage battery truck, unless the service lends itself to transportation over some continuous system of conveyor following a definite and fixed path of travel.

In the factory the necessity for space through which to operate power trucks calls for the orderly and effective location of machinery and equipment, for commodious aisles must be provided to allow the passing of trucks without undue interference with the activity of the machine operators, and sufficient room must be provided for the trucks effectively to serve as distributing agents between points of loading and unloading. This one provision which has to be made in the factory does not differ in any way from the passage clearance which must be maintained at freight depots, etc., so that a pretty clear standardization of the power truck has come about.

Standard Power Trucks

Storage battery trucks do not compete with or infringe upon the field of the powerful cranes and traveling bridges so essential in the intensive manufacturing requirements of the day; rather they are destined to make ever growing inroads into the field heretofore served by manual effort and hand trucks, so the standard power truck is, as a rule, either of one or two ton carrying capacity. The operator is customarily carried—the speed of the truck being from four to six miles, sometimes seven, an hour—upon a platform extending in advance or to the rear of the track platform or body. The width of the trucks (over all) has been standardized at four feet by most manufacturers, although some makes are not more than three feet, and the loading space of the average one-ton truck is 26 square feet, or so, making the overall dimensions for this smaller truck 4 by 7 or 8 feet,: with a wheel base in the neighborhood of 3 feet 10 inches. A couple of additional feet in the length of the loading space, calling for a wheel base of about 4 feet 10 inches, distinguishes the two-ton truck—as far as overall dimensions are concerned. The one-ton truck should be capable of turning on a radius of not more than 8 feet, while a two-ton truck should turn on a twelve-foot radius.

The battery box may be situated on the truck platform, or carried suspended from cross members of the frame—usually on springs—for protection and compactness, and provision should be made whereby the battery cells are readily accessible. The motor should have a high overload capacity to care for heavy starting torque and to enable the truck to negotiate fairly heavy grades under full load. A controller regulating the speed over a wide range—usually two or three speeds forward and as many on the reverse, with a positive stop between—is essential for safe service in the ordinary manufacturing plant where the truck is of necessity confined to passage in aisles and paths across which workers must occasionally pass, or where the trucks have to wind in and out about machinery, posts, etc.

Special Power Trucks

The success of the standard type of platform baggage truck, to classify the type according to the service for which it was originally designed, has led to the development of an almost endless line of storage battery power trucks for special lines of work, or particular service. The plain platform has been replaced with various styles of side-dumping, end-dumping and special bodies. The platforms have been constructed so they can be raised mechanically, horizontally or to an inclined plane for convenience in loading and discharging loads. There has been scarcely a type of hand truck construction which has not been duplicated in a power truck.

The efficient and convenient lifting trucks now share their special field of service with elevating power trucks having low, flat platforms which can

POWER TRUCKS MOVING A LOAD OF HAND TRUCKS
C. W. Hunt Co., New York

be run under cradles upon which compact loads may be placed, the platform raised and the loaded cradle carried to another location without manual handling

MERCURY TRUCK HAULING A LOAD OF TRAILERS IN A FOUNDRY
Mercury Manufacturing Co., Chicago

These elevating trucks are efficient and effective workers, for delays incident to loading and unloading are circumvented and the trucks kept effectively occupied with a minimum of interruption. [illegible] continuous service permits the trucks to render unusually high ton-mileage service.

HUNT TRUCK WITH [illegible]

Trucks with interchangeable bodies have been developed to meet the requirements of the manufacturer whose conditions are such that the character of the load can be effectively changed from time to time. Industrial trucks equipped with either hand power or mechanically operated cranes materially simplify the handling of heavy and cumbersome loads. The cranes load or unload the trucks, can carry a load in suspension and pick up or distribute loads over quite a respectable radius, permitting their effective use in localities not served by traveling cranes or other hoisting equipment.

ADAPTABILITY OF THE INDUSTRIAL POWER TRUCK

Conceived for freight handling, the employment of industrial power trucks to run in and out of box cars when loading and unloading freight, to scurry about freight depots, steamboat piers and the warehouses of industrial plants, logically follows, but some of the more special uses to which these compact and efficient vehicles are put are of interest.

Although replacing to a large extent the hand trucks, in many instances the power trucks have made possible the more extended and effective use of the manually operated aids. As an example, the hand trucks employed for collecting textile products from the various machines for transportation to other sections of the mill can still be used for gathering the materials and then run onto the body of an industrial power truck and much more expeditiously and conveniently transferred to other departments.

A service for which the industrial power truck is frequently employed with economy and convenience, though the service is very foreign to that for which the device was developed, is in spotting and switching freight cars. A two-ton power truck has a draw bar pull of 750 to 850 pounds, sufficient to haul an unloaded box car without taxing the truck batteries. Loaded cars can be switched about the yard with the aid of two or more trucks, often saving that delay entailed by waiting for a switching locomotive and discharging the service far more expeditiously and economically than would be possible if dependence were placed upon the movement of the car by laborers armed with crowbars.

The use of special types of bodies mounted on the platforms of the power trucks frequently develops quite marked economies and some very interesting devices have been developed. One is a self-dumping body for handling coal, a construction of the C. W. Hunt Co. A special shaped body is carried and balanced in such manner on inclined guide rails that, on releasing a latch, the weight of the coal is utilized to dump the body and the weight of the body to return it to its normal position as the truck advances from the coal pile.

Another ingenious power truck, one of the tilting platform type, is built by the Elwell-Parker Electric Company for handling heavy steel slabs. The tilting platform is pivoted to the rear axle of the truck and manipulated by a horizontal ram. Actuating the ram for loading or unloading moves the platform into an approximately vertical position with its front edges lowered to the ground. The steel slab is walked onto the edge, or toe, of the platform in loading and the ram manipulated so as to give the platform a suitable inclining position with the front edge of the platform raised a few inches from the ground for carrying the slab. A load of from two to three tons of steel slab can be hauled by one truck

DROP FRAME TYPE OF TRUCK, HEAVILY LOADED
C. W. Hunt Co., New York

and two of them can supply in a couple of hours enough slabs for a steel mill of considerable size, each replacing two or three men with hand trucks.

TRACTORS AND TRAILERS

When the tonnage to be handled is heavy and the hauls of considerable length, high ton-mileage can frequently be most effectively secured by a system in which a powerful truck serves as a tractor to pull a series of trailers upon which the load is carried, thus forming an industrial train unconfined by rails and free to be guided over any desired path. Heavy tonnage can be secured in this way, but the train is not as mobile nor as adaptable as the single industrial power truck. These limitations, despite the increased loads which can be transported, curtail to some extent the field of the trailer system. The system is an economical one for long hauls or where the tonnage to be carried is high, but its economy for hauls of less than 300 yards or so is doubtful.

To secure full economic returns from a tractor-trailer system, it is necessary to keep the tractor unit busy and apportion the unavoidable idle time to the comparatively inexpensive trailers; so, though any industrial power truck may be used as a tractor, it is not good practice to do so unless the battery and motor equipment designed for extra heavy work, for extra heavy work is essential if the full value of the tractor is to be realized. In one plant three C. W. Hunt Company tractors serve 420 trailers, handling an average total load of from 5 to 10 tons. These figures give a good idea of the service a well planned tractor-trailer system can discharge and discount the value of employing an industrial power truck as a tractor, even when the truck carries a load "on its back" while acting as a tractor. The truck is designed to *carry* a load and when effectively loaded its power equipment is economically utilized, if the truck is properly proportioned for its capacity, leaving only its reserve power capacity available for the haulage service. The result is that when a truck is used as a tractor its potential service as a truck is discounted, the number or capacity of the trailers reduced, and an unduly elevated expense made chargeable to the necessarily less actively engaged trailers.

An industrial power truck is essentially a vehicle for carrying a load, while a tractor is essentially a hauling mechanism. No economy is to be realized, therefore, by imposing the special work of either on the other, nor in attempting to make a specialized machine discharge work which is better suited to another machine. Occasionally diversion from such general rule can be made to advantage, it is true, as when a truck is used for spotting or switching freight cars, and not infrequently a light load added to the back of a tractor may save considerable time —possibly make unnecessary an additional trip. As a rule, however, it is well to utilize the power truck equipment for the service for which it is intended.

The tractor system is well suited for use in large shops with broad aisles, where a trailer can be run alongside a machine and left there until loaded, then to be picked up and hauled to the stockroom or to some other machine or department on the next trip of the tractor when it comes bringing another empty trailer to take the place of the loaded one. Another advantage of the trailer system in a shop where various parts and articles have to be transported is that individual trailers may be built to serve most satisfactorily for handling articles of various shapes, the parts gathered and distributed most effectively for subsequent operations and assemblies, etc., and an efficient system of freight handling and assortment instituted.

When a tractor trailer system is used in factory aisles and in other necessarily confined passages, the aisles should be somewhat wider than would be necessary for the use of individual power trucks, as the tractor with its trailers does not constitute such a mobile system as the unit equipment: more room is required for curves and provision must be made for inaccuracy in tracking. This disadvantage is discounted to a considerable extent by special trailers built so that both axles pivot, both wheel trucks caused to track through link and lever connections.

TRACTOR SERVICE

The use of tractors is by no means limited to hauling trailers, as customarily understood, about the industrial plant—large and important as is such field—for not infrequently a tractor is employed to furnish the motive power for handling trains of industrial cars on rails. The wheels of the tractors, in such service, usually span the industrial track, running on planks laid along the outside of the rails. Another quite common use of a power tractor is to haul numbers of hand trucks, such as are used extensively about industrial plants, freight terminals and depots. In fact, anything which runs on wheels, whether on tracks or not, can be handled economically and expeditiously by the industrial power tractor—provided, of course, the load is within the capacity of the machine.

BATTERY EQUIPMENT

Industrial trucks and tractors are almost universally equipped with either Edison iron and nickel battery cells or with some type of lead cell or from about 100 to 200 ampere hours capacity, depending upon the service for which the equipment may be destined. The Edison cells are to be recommended where the path of the truck or tractor is rough and the equipment subject to rough usage on account of the greater physical strength of the Edison cell, but the lead cell is electrically the more efficient.

Trucks and tractors furnished with lead cells weigh, on the average, some 10 per cent. more than similar equipment furnished with Edison cells, adding to the dead weight carried and also adding to the necessity of carefully considering the question of advisable battery equipment to employ for the conditions governing the character of service. The capacity of the batteries should be governed by the service required.

Operating Cost

An industrial power truck will cost from $1,200 to $1,500 up to two or three times that amount, depending upon the type, its capacity and the elaborateness of its equipment and a tractor somewhat more. A comparatively heavy investment is thus entailed for an installation of power trucks, therefore the probable returns promise at the present time to be of greater consideration than during the past few years when the deciding factor has been so largely a question of increased production.

In any installation in which a power truck can be effectively employed in service previously rendered by manual labor and hand trucks, the services of at least two, and frequently as high as eight or more men can be dispensed with. Valuing labor at $2.50 per day, the saving in payroll for the men displaced would be from $1,500 up to $6,000 or more per year, against which would have to be charged but a few hundred dollars to cover the higher wages the more skilled truck operator would command.

The expense for current should rarely exceed 30 cents per day for a truck—in fact, usually nearer 25 cents per day—and the average maintenance expenses with the burden of interest, taxes, etc., amount to about $1.50 per day per truck.

These approximate figures would appear to confirm the general claim of power truck manufacturers that the net saving in transportation expenses made possible by the use of an industrial power truck averages $8.00 to $10.00 per day. Still other confirmation is found in reports submitted during 1915. In a printing establishment operating one industrial truck for handling rolls of paper, etc., the average daily saving figured on a year's operation amounted to approximately $11.00. A manufacturer of automobile accessories employed an industrial truck with a saving in labor expense of close to $2,500 per year. Coal was so handled in another plant with a saving of $8.00 a day, and numerous other instances can be cited where the net savings realized by the use of power trucks for former hand trucking service run anywhere from $2.00 to $10.00 per day.

Industrial Coal for Next Winter

Program of the United States Fuel Adminis ration

Authorized by the U. S. Fuel Administration

During the current year ending March 31 next it is estimated that the United States will require 735,000,000 net tons of coal. It is not anticipated that this entire quantity can be mined and transported. Therefore the difference must be made up from savings. It is estimated that from 10 to 20 per cent. of the coal now consumed can be saved without curtailing production. The Fuel Administration has developed plans to instruct users of coal in ways and methods to prevent waste and obtain the maximum result from every pound burned.

THE United States Fuel Administration has gone far beyond the "blueprint" stage in its work of saving coal in the 250,000 industrial power plants of the United States. This is not to say that the best engineering intelligence and experience of the country has not been called upon in the task of finding and putting into effect the best methods of conservation. Even at this moment the system is not considered perfect, and if a better plan can be originated, or developed through experience, it will be adopted.

Coal and oil conservation measures are necessary, even if they are not popular in some instances. In the past, when the curtailment of non-war industry, "lightless nights," industrial power plant inspection and other orders and plans were put out a cry has been noted from some quarters: "Never mind about saving coal; it is the Fuel Administration's business to dig."

Now 700,000 miners are being urged to produce a maximum output of coal; mine operators, distributors and railroads are under urgent pressure to forward the distribution of a coal production which is now at the highest point ever reached by the coal mining industry.

Nevertheless, the Administration will keep right on with its work of saving coal and other fuel, and it *demands* the help of every loyal citizen.

It is the householder's war business to save coal, just as much as it is the business of the factory owner. But in order to effect the necessary saving, the householder and factory owner each must give it personal attention.

The Country's Coal Requirements

According to the estimates of the Administration 735,000,000 net tons of coal will be required to meet the demands of the country for the current coal year, ending March 31 next. With the progress of the war and the growing demand for coal this figure may be revised upward.

One hundred million tons of the requirements must come from the anthracite fields, leaving 635,000,000 net tons of requirements from the bituminous mines. The total bituminous production last year was 554,000,000 net tons, which makes necessary an increased production of 81,000,000 tons. The Fuel Administration does not anticipate that the bituminous coal production will go far beyond 600,000,000 net tons. The difference must be made up of savings.

The coal budget made up by the Administration shows that the requirements for industrial uses will be 242,024,000

In this emergency — possible the greatest of all national emergencies — it is the duty of the miners of the United States to produce the last possible pound of coal; it is the duty of the railroad operatives to transport coal to the last ounce of efficiency; it is the duty of industrial executives and householders to stop the disgraceful and criminal waste of coal; it is the duty of the United States Fuel Administrator to see that all these things are done.

tons, which is an increase of 18 per cent. over the estimated consumption for last year.

For domestic uses 75,678,000 tons of soft coal has been allotted.

The gas and electric utilities have been apportioned 37,941,000 tons this year, as against 33,038,000 tons consumed last year, an increase of 15 per cent.

The railroads require this year 166,000,000 tons as against 155,000,000 tons last year, the increase amounting to 7 per cent.

The mines themselves will use 12,500,000 net tons this year, whereas 11,000,000 tons sufficed last year. The increase amounts to 14 per cent.

Two million additional tons will be required to take the place of oil, principally in the West.

Seven million tons has been set apart to allow an additional ten days' supply outside the New England States.

Ten to Twenty Per Cent of Coal Now Consumed Can Be Saved

An annual saving of approximately 10 to 20 per cent., that is, 25,000,000 to 50,000,000 tons of coal per year can be made by correct operation of power plants. This saving relates to the measures which can be applied without the necessity of installing new or improved equipment, and the delay and expense occasioned thereby. It is a significant fact that a large percentage of the factory power plants in the country cannot render a true account of the production obtained from the coal consumed; neither do they know *how much,* in terms of steam, power, heat and light should be produced for each pound of coal properly used.

Factories are wasting 40 to 60 per cent. of their fuel by poorly conducted methods of operating, according to engineering reports. Essentials such as proper accounting methods of weighing the coal and water, regulation of air supply to the furnace, analyzing flue gases, preventing leaks through boiler settings, cleaning and access doors, covering exposed radiating surfaces, and proper supervision of power plants are all neglected, resulting in a great national waste of coal which could be saved by purely operating economies.

Industrial Executives Must Develop the Personnel of the Power Plants

The attention of plant executives should be drawn to the fact that much of the responsibility of this undertaking rests with them, and that it is their duty to learn more about the personnel of the boiler room. The human element entering into this work is of particular importance. Firemen like to feel that they are an important part in the great machine of industry. If they are encouraged in this thought and urged to think fuel economy and practice it to the best of their knowledge, elimination of the present needless waste of coal will be effected.

The Fuel Administration desires to assist plant owners in every possible way to overcome these inefficiencies in boiler-plant operation by means of an educational campaign for the efficient operation of steam boilers, as well as personal inspection and instruction as far as possible, so that as a result of such assistance proper methods of operating and accounting in boiler plants will eliminate this large unnecessary waste of fuel

This work is under the supervision of a State Administrative Fuel Engineer appointed in each of the important coal consuming states or districts, who, with the help of properly trained assistants will supervise fuel conservation in power plants, including both mechanical and electrical problems connected with the generation and use of steam, power, light, and heat. In addition to these functions, certain other fundamentals are incorporated:

Personal inspection of every power plant in the country.

Classification and rating of every power plant, based upon the thoroughness with which owners conform to the recommendations of the United States Fuel Administration, and according to information required by a questionnaire upon which is reported the actual working conditions of the plant.

The United States Fuel Administration Needs Engineers to Carry Forward Educational Campaign

The United States Fuel Administration seeks the aid of engineers and others possessing ability in boiler plant operation, who, moved by a patriotic desire to serve the country, are willing to volunteer their services for a part or the whole of their time in carrying this work to a successful conclusion.

Three district classes of men are required:

First, those having a technical knowledge of steam engineering who can serve as consulting engineers to power-plant operators; also as lecturers to the various civic organizations and plant committees for advocating the principles of fuel economy.

Second, men experienced in boiler-room practice to serve as inspectors of power plants for collecting certain definite information as required by the questionnaire. The rating of each plant will depend upon the efficiency of methods in use, which rating will automatically regulate the supply of coal of such plants.

Third, men engaged as power-plant supervisors who are practicing modern methods in boiler operation, and whose services can be called upon for temporary assistance to instruct operators in other plants who wish to improve their boiler room efficiency.

The Administration has in press a series of official bulletins on engineering phases of steam and fuel economies. They include:

1. Boiler and Furnace Testing.
2. Flue-Gas Analysis.
3. Saving Steam in Heating Systems.
4. Boiler Room Accounting Systems.
5. Saving steam and Fuel in Industrial Plants.
6. Burning Fine Sizes of Anthracite.
7. Boiler Water Treatment.
8. Oil Burning.
9. Stoker Operation.

Fuel Wastes Must Be Checked

An effective system has been laid out for the conservation of light and power, developed under the following subdivisions: Elimination of uneconomical isolated plants; application of the skip-stop to street railways; the regulaton of car heating and lighting; economy in utilization of power and light in factories; utilization of excess water power and interconnection of power systems; limiting the production of power to the most efficient plants available; economy in the refrigerating and ice manufacturing industry.

The plans are being carried out through the coöperation of a force of engineers organized and stationed with the Fuel Administration at Washington; the engineering department of the United States Geological Survey; the power division of the Council of National Defense, a State fuel engineer attached to the office of the State Fuel Administrator, to supervise the activities in his State; the public service commissions and State regulatory bodies; volunteer engineers located throughout the country.

The individualistic way in which fuel is now consumed in cities is not efficient. A ton of coal burned in a large central station will produce at least four times as much electric power as if burned in the average small plant, and if centralized burning could be introduced to a greater extent, the amount of fuel required could be largely reduced without reducing in any way the ultimate production of light and power.

The Fuel Administration believes that if even a comparatively small proportion of the plants throughout the country which could save fuel in this way at a profit to themselves would do so, it would prove a tremendous help in meeting the fuel situation with which the country is confronted.

One of the most promising methods by which the Administration is securing economy in the use of fuel throughout the country is the introduction of the skip-stop system on electric railways.

With the practice of having cars stop on signal at any street corner, there are usually from 12 to 14 stopping points per mile. With the skip-stop system, properly applied, these are reduced to not more than 8 per mile in the business districts, 6 per mile in residence districts, or 4 per mile in the open country. With the number of stopping points decreased in this way, a saving of from 10 to 15 per cent. can ordinarily be effected in the power (and hence in the fuel) required, while at the same time the average speed of the cars is increased (without any increase in the maximum speed) and the service thus improved. Since this measure secures economy in fuel not only without handicapping the service, but with an actual improvement, it is obviously an extremely desirable type of conservation measure.

Shop Committees to Save Fuel

The United States Fuel Administration is requesting, as a means of accomplishing power and light conservation in manufacturing and industrial establishments, the appointment, by the management, of a shop committee, composed of those best suited for the purpose and in size or number suitable to the size of the plant, one member of this committee to act as its chairman.

As an illustration of possible waste and opportunity for conservation, the Administration suggests the following items: Lights being unnecessarily burned; lamps of too high candle power; elimination of arc lamps and substitution of nitrogen filled lamps which are from two to three times as efficient; restricted use of sunlight due to dirty windows; operation of motors when machinery is idle; excessive sparking, heating or erratic speed of motors; improper alignment of shafting; grouping of machines so as to operate motors or engines as nearly loaded as possible, staggering of operations so as to maintain as flat a load curve as possible; slipping belts; dry bearings; overheated or underheated parts of plants; excessive drafts due to lack of proper protection about openings of doors, windows, elevator and staircase areas; reduction of elevator service or the application of a skip-stop to elevator service; testing out of power circuits for relationship of capacity to load carried; paralleling of power circuits.

Interconnection of Present Power Systems

A method of fuel conservaton which promises a certain amount of immediate relief and at the same time opens up a field with almost limitless possibilities for future development is the interconnection of the present power systems of the country, and the consequent utilization of excess water power

The restriction of non-war industries, as now worked out, throws the greater share of the work on the War Industries Board. It is still planned to investigate and put necessary restrictions on those plants which burn large quantities of fuel.

The Administration is in touch with the ice industry and is introducing proved economies in the operation of ice and refrigerating plants.

A further line of effort which will be productive of considerable economy and one that was successfully applied last winter is that of operating during the winter season only the most efficient plant, or plants, as the particular case requires, in communities where, during the summer season, all plants are required. This can be done and the individual business of each manufacturer will not be interfered with as the arrangement provides that the operating plant will sell at wholesale rates to manufacturers whose plants are temporarily closed.

Problem of Fuel Transportation

The production of coal in this country is fundamentally a transportation problem. There are enough coal cars and enough locomotives to transport the necessary quantity of coal only if every car and every locomotive is used to its maximum capacity every day in the year.

The country needs the greatest utilization of the coal-carrying facilities every week and every month. It has no surplus cars and no surplus locomotives to carry more coal in a succeeding week or in a succeeding month to make up for the failure to use the existing cars and locomotives in a preceding month.

Owing to more favorable weather conditions, a greater quantity of coal can be transported each day from April to November than is possible in each day from November to March. Conditions adverse to coal transportation are sure to exist every winter. Such adverse conditions were unusually severe and long continued in the winter just passed.

There is plenty of coal in the ground to meet every need. This coal can be taken from the ground only in consequence of orders placed with the operators. If those orders are delayed the coal remains where nature put it. Coal operators have no other storage space for their coal. Even if such storage space existed it would be of little benefit. The coal might as well remain in the mines as be stored at the mouth of the mines.

Unless the operators have orders for their coal they cannot load the coal cars, nor will the coal cars be placed at their mines. Without orders for coal the operators cannot ship it.

With the exception of limited storage capacity in retail dealers' yards, there are only three places where coal can be kept. First, in the ground, where it has always been, and where it must remain until mined and loaded into cars. Second, in the cars themselves, where, unless those cars are promptly moved to their destination and unloaded, it is a hindrance to transportation, blocking up tracks and yards already overtaxed and sadly needed for transportation of other commodities. Third, in the coal bins of domestic consumers, and in the coal piles of industrial users. The value of coal as fuel begins only when it reaches the third place.

Orders for Coal Should Be Placed at Once

The Fuel Administration, through the State fuel administrators and local committees, is prepared in every reasonable way to aid public utilities, essential industries, retail dealers, and domestic consumers in placing their orders and in securing assurance of a sufficient supply of fuel. All these Government agencies, however, are powerless if the consumers themselves fail to act.

Maximum Fuel Production With Minimum Fuel Waste

By David Moffat Myers

[illegible] this country through the coming winter months. It is estimated that the elimination of easily preventable wastes will save 50,000,000 *tons of coal during the current year ending March* 31, 1919.

Mr. David Moffat Myers *following* 1901 *was mechanical engineer for the United States Leather Company. He made a particular study of steam and fuel conditions, including the burning of tanbark and waste chips. Since [illegible] he has been in consulting work, specializing on investigations and improvement of power plants in industry and supervising their operation to gain higher efficiency.* Mr. Myers *is now advisory engineer to the United States Fuel Administration and Chief of the Fuel Engineering Section.*

BROADLY speaking there are two methods of conserving the supply of fuel. One way is to curtail the production of manufactured commodities. The other by the application of modern engineering causes a pound of fuel to generate more of power light and heat and thus makes for the maintenance of 100 per cent. production with the same supply of fuel.

For illustration, take the hypothetical case of five industrial plants of equal fuel requirements. It becomes necessary to reduce their coal consumption by 20 per cent. The first method of conservation might compel the shutting down of the one plant out of the five whose product was considered of the least important to the country, in order that the other four plants might operate at full capacity; or if all were of equal importance the production of each might be reduced 20 per cent. The alternate plan prescribes the adoption of scientific methods in the generation and utilization of power, light and heat in all five of the plants. They would not have to differ very widely from average plants of today in order to save 20 per cent. of their coal and still operate all five of them at full capacity.

In the average manufacturing plant the cost of fuel per unit of finished product is a very small fraction of the present high price of coal. In many cases this fuel cost will not be over 3 per cent. of the total. This would mean that the conservation of $100 worth of coal by the curtailment or negative method would deprive the country of $3,333 worth of production.

The object to be desired therefore is "*maximum production with minimum waste*" and these words form the slogan of the campaign now under way.

National Plan of Fuel Conservation

This proposition, involving construction economics together with the development of a national plan and organization for its execution, has been one of the contributions of the engineering profession to the United States Government in the present crisis. The plan has been endorsed and adopted by the United States Fuel Administration and is administered through its conservation division.

Before deciding upon the administrative and engineering features involved, the plan was first submitted for constructive criticism to the Federal Fuel Administrator for each of a group of states which together consumed 70 per cent. of the coal. Representative engineers in each of the principal coal using states were called into consultation respecting the technical features; also business men, manufacturers and representatives of Chambers of Commerce, as well as state conservation committees and councils of defence.

In the original construction of the plan the United States Bureau of Mines, and the Committee of Consulting Engineers representing the four great National Engineering Societies performed a notable and valuable service, and these organizations act as permanent advisors to the United States Fuel Administration. The initial survey contemplated three special fields of activity; railway fuel constituting 28 per cent.; power plant fuel about 40 per cent. and house heating 12 per cent. or a total of 80 per cent. A 10 per cent. saving in these three fields means an economy of 50,000,000 tons of coal.

Railway Fuel Saving Campaign

The railway fuel saving campaign was organized under Major Edward C. Schmidt and was later taken over by the United States Railway Administration in connection with which he is now engaged.

A house heating campaign along the lines of the national plan for the industries is now in process of formation in Washington.

In the power plant field, which includes the industries a comprehensive plan has been developed and is now in operation in six states or districts and is being rapidly extended to the other large coal using states. At present efforts are to be directed principally toward the attainment of those economies in fuel which can be effected by improvements in operation alone.

Realizing the difficulty and delay incident upon the installation of new equipment, the administration for the time being merely requires a plant owner to operate his present equipment as efficiently as possible. A thorough execution of this measure will in most plants result in a saving of 10 to 20 per cent. In persuance of this policy a standard set of recommendations covering the operation of power plants has been prepared together with a parallel group of questions which will be sent to every power plant owner. The answers to the questions, which are graded as to economic value, will determine on a percentage basis how closely an owner is following the recommendations of the administration. This will determine the class in which his plant will be rated and he will be given opportunity for obtaining higher ratings as he brings his operation closer to the standard set by the recommendations. The plants of high rating will be given the preference in coal delivery in times of shortage. In other words those who assist the government in conserving fuel by efficient methods in their plants will receive advantages over those who continue to use old-fashioned methods.

Supervision by Administrative Engineers

An administration engineer is appointed in each state by Washington to supervise the work of fuel conservation. He becomes a part of the State Administrator's organization and with his staff of assistants constitutes the necessary machinery for executing the additional function of the state. Each administrative engineer has an advisory board or conservation committee.

Refrigeration and Ice Making

By Charles L. Hubbard

The problem of supplying refrigeration and producing artificial ice in military camps and on shipboard involves the same principles as are solved in the application of refrigerating machinery in industrial and other establishments. This article shows examples of such apparatus and machinery.

Mr. Charles L. Hubbard *has had an extensive experience in the design and installation of power-plant machinery and for the past ten years has been in private consulting practice in Boston. He is a frequent contributor to engineering journals on power plant and kindred topics, and the author of "Power, Heating and Ventilation," and other well-known and widely used text books on thermodynamics.*

IT is evident that the principles of refrigeration, and the general form of equipment employed, are practically the same, regardless of the location and the particular uses for which the plant is constructed. The requirements of military camps are varied, depending upon their size and whether they are temporary or permanent. Between these extremes are the semi-permanent camps, where the period of occupancy may vary from a few weeks to several months. In the large cantonments now in use by the Government the equipment for refrigeration takes on the form of a permanent plant, except, perhaps, in the construction of the building which houses it. Under these conditions the selection of a system and its auxiliaries follows the general lines for an ordinary commercial plant of similar size and requirements.

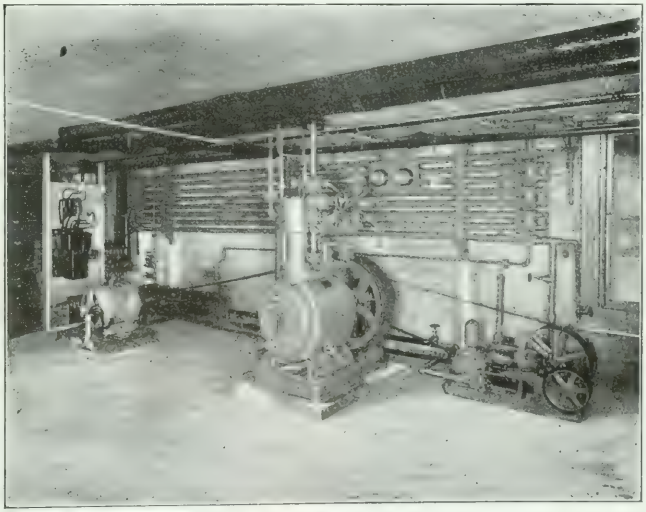


FIG. 1 [illegible] COMPRESSION PLANT
[illegible]

If the camp is equipped with its own lighting plant the exhaust steam may be utilized in the generator of an absorption machine if desired. This would provide refrigeration during the period of lighting and live steam could be drawn from the boilers during the day. If electricity were purchased from an outside source a compression plant would probably be more desirable, although steam would be required for cooking, in any case, and the boilers could be enlarged sufficiently to care for the refrigerating plant also. These, however, are matters for local consideration. Camps of this kind usually require refrigeration both for cold storage purposes and ice making, and in some cases an air-cooling equipment also for hospital wards.

The water supply of a military camp is a matter of vital importance and one which is closely connected with that of refrigeration. If pure water is brought in from outside it may be simply a matter of cooling that used for drinking purposes during the summer months, but if this is not available it may be necessary to put in a distilling plant also for furnishing the water required for drinking and cooking. As the camp becomes less permanent, it is necessary to employ equipment which is easily dismantled and set up in a new location, thus bringing into use comparatively small units of a portable or self-contained type. In case of the smallest outfits the principal parts are mounted upon a single metal or wooden base, so as to reduce to a minimum the piping which must be disconnected and made up again when the camp is moved. As the size increases the number of sections or parts must also be increased, so as to permit of easy transportation. One of the best arrangements is to mount the entire outfit upon a motor truck or trailer so that it may be ready to move from place to place with a minimum of preparation. For larger machines the compressor, condenser, etc., may be placed upon one truck and the refrigerator or ice-making equipment upon another, in which case dismantling will consist in simply uncoupling the pipes between the two pieces of apparatus. In general, however, it may be more satisfactory to employ a larger number of small units, the entire outfit being mounted upon a single truck. If, however, maximum mobility is not of the first importance, each unit may be split up into two or more sections, as previously mentioned. For service of this kind the compression machine, driven by a gasoline engine, most nearly fulfills the requirements, although electric motors may often be employed to advantage where the camp is equipped with electricity. Another arrangement is to provide a secondary clutch, so placed that the truck engine may be used for driving the compressor and pumps.

Having outlined briefly some of the special requirements in connection with refrigeration for military camps, we will now take up a few of the special processes involved and the equipment commonly used.

Equipment for a permanent camp ordinarily consists of the refrigerating machinery, the cold storage rooms, an ice-making set, and a water-cooling outfit for supplying drinking water in the summertime. Hospitals, except on a comparatively small scale for emergency use and minor ailments are usually located by themselves at some distance from the main camps, so that air-cooling is not strictly a part of the regular camp refrigeration, although quite closely connected with it.

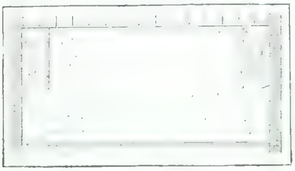


FIG. 2. ONE ARRANGEMENT OF ACCELERATING AIR CIRCULATION IN COLD-STORAGE ROOMS

Cold Storage.—As already stated, the system employed may be either of the compression or absorption type, and direct expansion or brine coils may be used for cooling the storage rooms.

A typical six-ton compression outfit adapted to this class of work is illustrated in Figure 1. The compressor is of the vertical enclosed type, motor driven, and the ammonia condenser, mounted upon the side wall, is of the double-pipe, water-cooled form. The whole outfit is compact and easily erected for semi-permanent use. In arranging the cooling surface within the compartments care must be taken to provide for a circulation of air over the coils in order to equalize the temperature throughout the space. There are various ways of doing this, one of which is shown in Figure 2. Proper insulation is another detail which must be given careful consideration, for after the compartment and its contents are once chilled it is only necessary to remove such heat as finds its way in through the walls; therefore, the rate of transmission has a direct bearing upon the cost of refrigeration. Typical methods of insulation for buildings of wooden construction are shown in Figures 3. 4 and 5, which are for wall, ceiling and floor, respectively.

Other forms of construction are used, but these serve to show the general principles to be followed. For temporary use the walls may be double boarded with sawdust or shavings between. As air is the real insulating material, the method of construction should be such as to confine it in thin layers and finely divided spaces. The different rooms or compartments are furnished with sufficient piping to maintain them at the proper temperature, and are classified as *coolers, holding freezers* and *sharp freezers.*

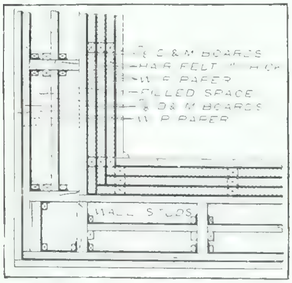


FIG. 3. WALL INSULATION FOR ALL WOODEN CONSTRUCTION

The temperature for coolers commonly ranges from 30 to 40 degrees F., holding freezers 0 to 10 degrees and sharp freezers from 10 degrees to 0. These temperatures, however, apply especially to commercial cold storage plants, where meat and poultry are frozen and kept for long periods. The conditions of camp refrigeration are somewhat different from this, as most of the perishable supplies are brought in at more or less frequent intervals and are stored for a comparatively short time, the conditions being more like those in a large hotel. For this purpose "cooler" temperatures, ranging from 30 to 40 degrees F., will meet all usual requirements.

Ice making.—In a camp equipped with cold storage and water coolers, ice is not required in large quantities. There is, however, a call for it for various purposes, and it is customary to provide an ice-making set in connection with the refrigerating plant. The can system is employed for this purpose, in which the water is frozen in galvanized iron cans placed in a tank of brine which is maintained below the freezing temperature by means of ammonia coils. In manufacturing ice in connection with general refrigeration it is only necessary to provide a branch pipe and expansion valve for admitting liquid ammonia to the freezing coils of the ice machine. By means of this independent expansion valve it is possible to carry any lower temperature which may be necessary. After the ice has been made it may be stored for use in rooms maintained at a temperature slightly below the freezing point.

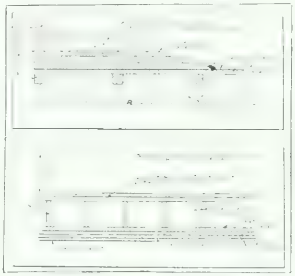


FIG. 4. FLOOR INSULATION
FIG. 5. CEILING INSULATION

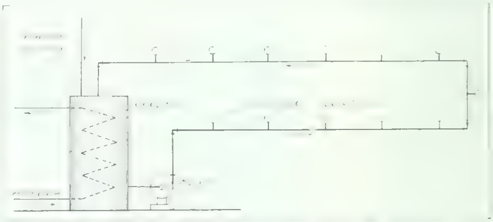


FIG. 6. DIAGRAM SHOWING WATER COOLING SYSTEM

Cooling drinking water. An ample supply of pure

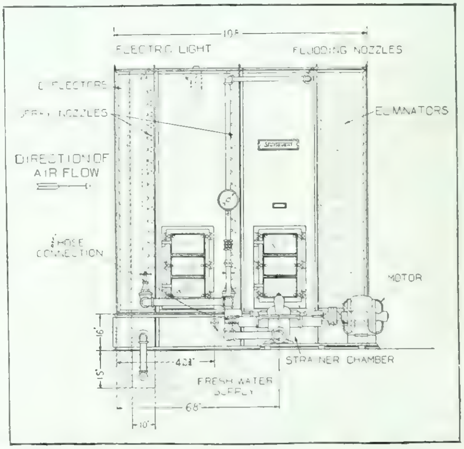


FIG. 7. SECTION THROUGH AIR WASHER USED FOR COOLING PURPOSES

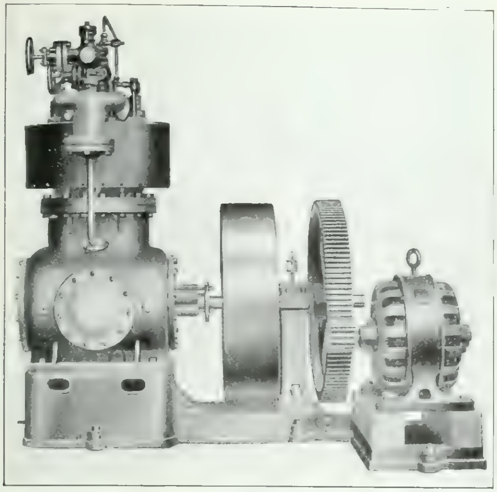


FIG. 8—COMPRESSOR OUTFIT ADAPTED TO PORTABLE USE WHERE ELECTRIC POWER IS AVAILABLE

drinking water should be furnished at a uniform temerature of 45 to 50 degrees F. in warm weather. Where the camp is of a permanent, or semi-permanent type, water coolers may be attached to the refrigerating system which must be so designed that provision is made for the hottest weather, and for that reason an allowance of about one quart per hour per man, including waste, should be taken as a basis. A diagram of a system of this kind is shown in Figure 6. The extent of each unit will depend upon the size of the camp. The water may be distributed from a central cooling tank or a number of smaller tanks may be used, each supplied with refrigeration from a central system.

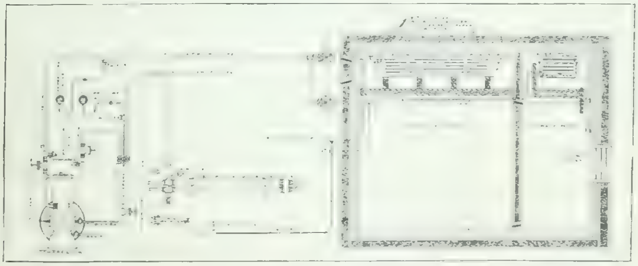


FIG. 9.—DIAGRAM OF COLD-STORAGE PLANT WHICH IS EASILY ADAPTED TO PORTABLE USE

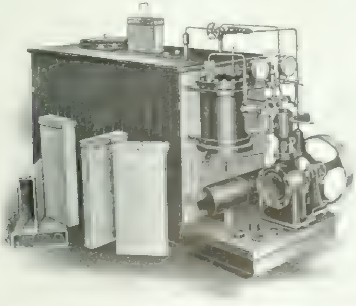


FIG. 10.—BRUNSWICK PORTABLE ICE-MAKING OUTFIT ADAPTED TO CAMP USE

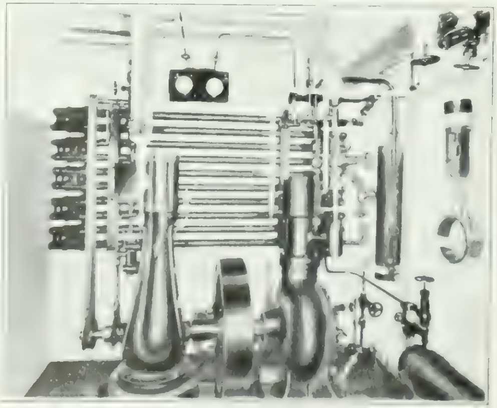
Water purification. When the water supply is not of the required purity it must be brought up to the necessary standard by such processes of purification as conditions call for. These may vary from simple boiling and filtering up to complete distillation. The essential parts of a distilling equipment are a steam boiler, condenser, skimmer, reboiler, cooler and filter. If steam engines are used in connection with the camp power plant the exhaust steam may be used, so far as it goes, after removing the oil by means of a baffle-plate separator. The condenser is of the same general type as the ammonia condensers previously described, and may be either of the atmospheric or double-pipe form. After condensing, the water is passed through the hot skimming tank to remove any oil which may have passed the separator, and then reboiled to drive out the air and gases which may remain. The water is then cooled and filtered, after which it is ready for the final cooling before distribution.

Air cooling. Air cooling in hospital wards may be done in three ways. The simplest, and naturally least effective, is the small electric fan so adjusted as to produce a gentle movement of air over the patient, but not strong enough to create a harmful draft. The next method, and one which tends to lower the temperature of the entire room, is to blow air over coils filled with cold brine. This requires an electric fan, usually of the blower type, and a system of ducts for distributing the cool air to the different rooms. Arrangements are sometimes made so that steam can be turned into the coils in the winter for heating, and brine in the summer for cooling. When the plant is likely to be more or less permanent, cooling is often combined with general ventilation by using an air washer, cooling the spray water by means of brine coils placed in the tank below the spray nozzles and eliminator.

An air washer of the general type employed for this purpose is shown in section in Figure 7.

PORTABLE EQUIPMENT

Having considered some of the requirements where the conditions are more or less permanent, let us now turn our attention to cases where mobility is of first importance



[illegible] MAKING REFRIGERATING OUTFIT

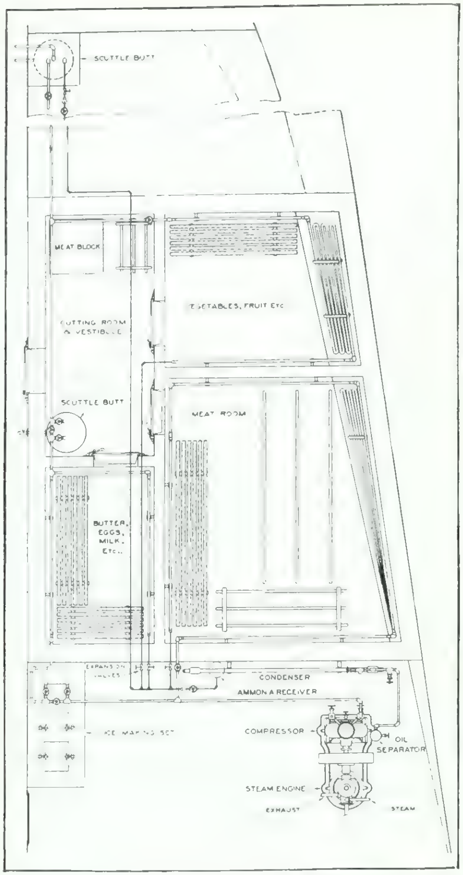


FIG. 12—TYPICAL LAYOUT FOR A TWO-TON REFRIGERATING AND ICE-MAKING PLANT ON SHIPBOARD

Cold storage of food supplies. Equipment for this purpose consists of the refrigerators or "cold boxes" which may be of the usual type, as large as can be conveniently carried upon a truck.

These are usually provided with coils for the direct-expansion system of cooling, as this eliminates brine tanks and pumps. However, the double-pipe brine cooler is simple and compact, doing away with the use of tanks and may be used if preferred. Refrigerators equipped with congealing tanks are not objectionable, because the tanks are small, and may be emptied during transportation and refilled with brine when wanted for use.

For the larger units the cold-storage compartments may be mounted on one truck and the compressor, condenser and receiver upon another, as previously stated. In case of the smaller one the entire outfit may be mounted together, the condenser and receiver usually being hung upon the side of the refrigerator.

A type of compressor well adapted to this class of work is illustrated in Figure 8. This is of compact design with enclosed casing and may be driven either by a gasoline engine or geared electric motor, as shown. The choice of prime mover must be determined by the circumstances of each installation considered. A diagram of a complete equipment of this kind is given in Figure 9. In its practical arrangement upon a truck the condenser and piping would be folded back upon the side of the storage room with the compressor at one end, thus making the whole outfit as compact as possible. Ammonia condensers of the double-pipe type are best adapted to this class of work, being of minimum size and self-contained.

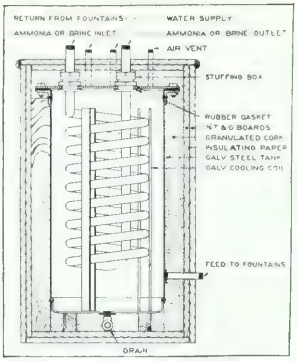


FIG. 13.—SECTION SHOWING CONSTRUCTION OF SCUTTLE-BUTT OR WATER COOLER

Ice Making.—Portable ice plants, employing the can system, are available, a typical machine of this kind being shown in Figure 10. This has a capacity of 120 pounds of ice in 10 hours. It is self-contained, the entire outfit being mounted upon a single base. The compressor is belted and may be driven by a gasoline engine or electric motor, as most convenient. The empty cans in which the water is frozen are shown at the side of the brine tank, which is enclosed in wooden sheathing as a part of the insulation.

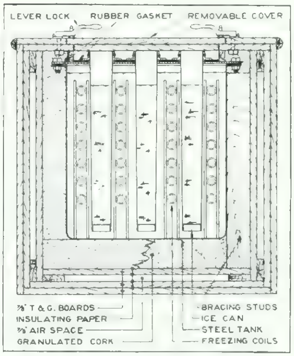


FIG. 14 SECTION THROUGH MARINE ICE-MAKING TANK AND FREEZING CANS

Refrigeration on Shipboard.—This, on passenger and freight boats, is similar to the requirements of a hotel or restaurant, except where provision is made for carrying meats and other perishable cargoes, in which case a regular cold storage equipment of large size is necessary. For preserving the ship's stores, dry refrigeration, such as is furnished by mechanical means, is much to be preferred to the use of ice. The melting ice invariably produces moisture, which causes the meat to turn black and thus require trimming, with the resulting waste.

As illustrating the general efficacy of mechanical refrigeration on shipboard, it may be mentioned that each year thousands of tons of meat are successfully carried in refrigerated vessels, from Australia, New Zealand and Argentine Republic to the market of Great Britain. Fruit is also transported to distant points by the same system, pineapples from the Hawaiian Island and Cuba, bananas from Central America, and apples from Oregon and Washington are all being successfully carried in refrigerated ships.

An important advantage of mechanical refrigeration over ice is the ability to maintain different temperatures in different compartments, according to the nature of the provisions stored. For example, the daily meat box may be kept at 34 to 38 degrees F., vegetables 40 to 45 degrees F., butter and eggs 32 to 36 degrees F. and meats for use on return trip or for later use on a long voyage at 18 to 24 degrees F.

Under the icing system the ship is required to purchase much of its ice abroad at prices from two to ten times those in America. A complete marine outfit of two tons capacity is shown in Figure 11. This cools the refrigerator for the ship's stores, it being divided into various compartments for meats, vegetables, dairy supplies, etc., besides making sufficient ice for table use and cooling two "scuttle-butts" or water coolers located at different points. The complete machine, including the compressor, engine, condenser, etc., together with the connecting piping, is installed in a space only 6x8 feet.

The passenger ship, and occasionally the freighter, will require in addition to refrigeration for the storage of foods a certain amount of ice for table use. This may be made by the same machine which furnishes general refrigeration by installing a suitable auxiliary equipment. If it is found more convenient and economical in any particular case to carry the ice than to make it, the amount required for the trip is placed in the ice chamber and then kept at a temperature of 28 to 32 degrees F. by the refrigerating machine, thus preventing loss by melting. On other ships it may be more desirable to make the ice, which will commonly average from 100 to 250 pounds per day, depending upon the crew.

A typical layout for a two-ton refrigerating plant on shipboard is shown in Figure 12. This equipment cools the meat storage, vegetables, dairy products and cutting room. It includes an ice-making set and two scuttle-butts, one of which is located in the cutting room and the other in the after part of the ship.

A typical scuttle-butt or water cooler is illustrated in Figure 13. It consists of a heavy galvanized iron tank containing a brine or ammonia coil, as shown, the whole being thoroughly insulated. An ice-making set of small size adapted either to marine or camp work is shown in Figure 14 and illustrates the construction and general arrangement of the freezing coils and ice cans.

A Time Study of Variable Operations

From a Study of Piling Lumber Production Increased 85, Labor Cost Dropped 28, Wages Increased 32 per cent.

By Carle M. Bigelow

Complete details are given of the operations and time studies for piling lumber on a steel kiln car where the pile varied in height as it rose and the boards differed in width and thickness. The satisfactory results from the study and the adoption of the rates based upon it prove the value of the method followed as applied to variable operations.

Mr. Carle M. Bigelow *has had some six years' experience in studying manufacturing operations, having been with the Glenlyon Dye Works as operative, gang boss, time-study man, engineer and division superintendent from 1912 to 1916. In the latter year he became senior engineer on the staff of Cooley & Marvin Company and in September, 1917, became chief engineer of that firm in charge of all of the technical and engineering work. He is an associate member of A.S.M.E.*

THE opinion is often asserted that unit time study can only be applied to operations consisting of definite repeated sub-operations; that when the sub-operations become variable, over-all time studies only are possible.

To prove this a fallacy and to illustrate how any operation, however variable be its units, will yield to scientific unit time study, is the purpose of this article. The limits of the variables may be determined and by proper classification the variable units grouped into fairly constant classes, for every variable approaches a constant as a limit.

Wherever it is desired to set a standard of time for the purpose of wage payment, unit time study should be employed, as it is the only means whereby a true standard may be obtained, and time standards are worse than valueless unless true.

The example selected is the piling of lumber upon a "bunk" or steel kiln car from an adjacent lumber pile. An illustration of the operation and surroundings is shown in Figure 1 on page 110

Nature of the Operation

The operation consists in placing the bunk in position on the track leading to the kilns and placing four bearing boards upon it. Boards for kiln drying are piled on these, leaving approximately a three-inch air space between the boards.

The operation is divided into two tasks, depending upon the number of cross sticks between the layers. The number of these cross sticks is dependent upon the thickness of the lumber. Experimentally it was determined that nine cross sticks are necessary to prevent warping for 1-inch lumber or thinner, and but seven cross sticks are needed for lumber 1¼ inch thick and over. Therefore, the task for piling bunks of lumber 1 inch thick or less (LB-1) provided for the use of nine cross sticks, and the task for lumber 1¼ inches thick or over (LB-2) allowed for seven cross sticks.

Teaming the Men

The operation requires two men. The author admits that it is bad practice to work men in teams with a single production result, but as part of the operation requires two men, being beyond the physical capacity of one man, and as other work in the department usually requires the joint service of two men, it was thought best to create the team rate. Men are allowed to choose their own partners; therefore, if the mutual bonus earnings decrease due to soldiering on the part of one member of the team, the ambitious individual goes to the planning department and demands a new partner. In several months we have had but one such complaint. Bonus records showed this justifiable and we transferred the criticised operative.

Lumber for piling is received on trucks located beside the bunks, the relative position being shown in Figure 2. These trucks are piled and delivered by a separate team working under another task. The supply, therefore, is standard and constant in every factor. One man stands at each end of the supply truck. They take a board by the two ends and move together until the board is in proper position above the bunk, when it is placed. Comparative times were taken when the boards were picked up two or three at a time, moved above the bunk, and the two or three boards laid down, picked up and placed, one by one. The handling of boards singly was found to be easier and quicker.

Studying the Variables

We will now note the variables. It was found that a longer time was required to place a board on the side of the bunk away from the supply truck than upon the side of bunk in proximity to it. This variable was limited by dividing the bunk into three imaginary vertical sections, shown as Numbers 1, 2 and 3 on Figure 2, and timing the placing of the boards in each section separately, the time of which was found to run quite constant.

Next, the limit of handling by this method due to height was determined experimentally and set at 52 inches above the surface of the truck. Above this height, one man stands on the floor handing the lumber to the second man, who stands on the pile and places the boards. The placing of boards in the three imaginary divisions was found to limit the variable properly for both men when working in this position, for not only does it take longer for the man on the bunk to move to the farther side to place the board, but the man on the floor is in consequence required to wait that additional time before handing up the next board.

The final variable results from the method of piling required to avoid warping. Wide boards tend to warp more readily during the kilning operations and, therefore are piled in the centre of the bunk, where greater pressure will be exerted upon them by the cross sticks, to hold them straight. This results in fewer boards being piled in the center, or No. 2 section, than in No. 1 and 3 sections.

Solution of the Problem

The actual solution of the problem is now detailed:

IB 1. Lumber 1 inch thick or less, requiring nine cross-sticks to pile.

Analysis. (Note: Prefix "a" in front of operation symbol denotes two men working on floor. Prefix "b" in front of operation symbol denotes one man working on floor and one man on bunk.

		Minutes
aB.	Place cross sticks, two men on floor	0.32
bB.	Place cross sticks, one man on floor and one man on bunk	0.65
aC.	Lifting and placing board, two men on floor (in section 1)	0.06
	(in section 2)	0.07
	(in section 3)	0.08
bC.	Lifting board, one man on floor and one man on bunk (in section 1)	0.07
	(in section 2)	0.08
	(in section 3)	0.09
bD.	Place board, one man on floor and one man on bunk (in section 1)	0.06
	(in section 2)	0.07
	(in section 3)	0.08
K.	Punching time card	2.0
L.	Get up on bunk	1.0
P.	Place bunk	3.25

Data. Approximately 2,000 board feet per bunk; 30 layers are piled with two men on floor; 20 layers are piled with one man on floor handing up lumber, and one piling on bunk.

For aC operation, boards placed in locations 1, 2, 3 (see Figure 2) we found to be variable, as follows

Number of boards	*Location of boards*	*Boards per layer*
50	1	2.38
48	2	2.28
49	3	2.34
	Average,	7.00

With an average of 7 boards per layer, there would be in 30 layers

Number 1 boards 30 × 2.38 = approximately.... 71 boards
Number 2 boards 30 × 2.28 = approximately.... 69 boards
Nmuber 3 boards 30 × 2.34 = approximately.... 70 boards

Average, 210 boards

Time for aC-1, 71 x 0.06 = 4.26 minutes
aC-2, 69 x 0.07 = 4.76 minutes
aC-3, 70 x 0.08 = 5.60 minutes

14.62 minutes, complete time for aC operations on one bunk.

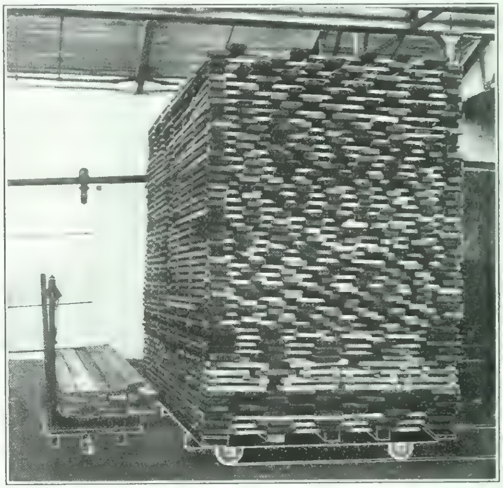


FIG. I. BUNK, OR KILN CAR WITH LOAD OF LUMBER

Timing the piling with one man on the floor and one man on the bunk, for bC and bD operations with boards placed in Number 1, 2, and 3 locations we have:

Number of boards handled during timing	*Location of boards*	*Boards per layer*
23	1	2.6
21	2	2.3
24	3	2.7
	Average per layer	7.6

With an average of 7.6 boards per layer and 20 layers per bunk, there would be

of Number 1 boards 20 x 2.6 = approximately 52
of Number 2 boards 20 x 2.3 = approximately 46
of Number 3 boards 20 x 2.7 = approximately 54

152 boards in 20 layers.

Time for bC-1, 52 x 0.07 = 3.64 minutes
bC-2, 46 x 0.08 = 3.68 minutes
bC-3, 54 x 0.09 = 4.86 minutes

12.18 minutes, complete time for bC operations on one bunk.

Time for bD-1, 52 x 0.06 = 3.12 minutes
bD-2, 46 x 0.07 = 3.22 minutes
bD-3, 54 x 0.08 = 4.32 minutes

10.66 minutes, complete time for bD operations on one bunk.

SYNTHESIS.—Let *T* equal time in minutes to load 100 board feet on bunk, and 30xaB equals time for placing cross sticks on 30 "a" layers.

$\frac{30xaB}{26} = \frac{30x0.32}{26} = 0.369$ minutes = time for placing cross sticks on layers in "a" location per 100 board feet = r.

20xbB equals time for placing cross sticks on 20 "b" layers.

$\frac{20xbB}{26} = \frac{20x6.5}{26} = 0.50$ minutes = time for placing cross sticks on "b" layers per 100 board feet = s.

14.62 minutes equals complete time for lifting boards into "a" location on one bunk.

$\frac{14.62}{26} = 0.563$ minutes equals time required per 100 board feet to lift boards into "a" location.

z = per cent allowance for rest and delays, lifting and placing boards with two men on floor equals 15 per cent.

1.zx(0.563 minutes) = 1.15x(0.563 minutes) = 0.648 minutes = allowed time per 100 board feet for placing "a" boards = t.

12.18 minutes equals complete time for lifting boards into "b" location on one bunk.

$\frac{12.18}{26} = 0.468$ minutes equals time required per 100 board feet to lift boards into "b" location.

z = per cent allowance for rest and delays (one man handling) equals 31.5 per cent.

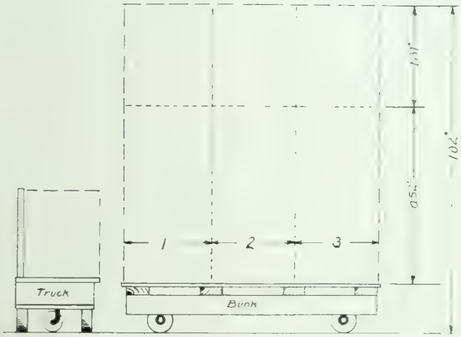


FIG. 2. DIVISION OF LUMBER ON BUNK INTO SECTIONS FOR TIME STUDY

1.z (0.468 minutes) = 0.615 minutes equals time allowed per 100 board feet for lifting "b" boards = x.

10.66 minutes equals complete time for placing boards into "b" location on one bunk.

$\frac{10.66}{26}$ minutes = 0.41 minutes equals time required per 100 board feet for placing boards into "b" location on one bunk = y.

$\frac{K+L+P}{26} = \frac{2.0+1l+3.25}{26} = 0.24$ minutes equals time per 100 board feet for making up bunk, punching time card, etc = p.

$T = r + s + t + x + y + p = 0.369 + 0.50 + 0.468 + 0.615 + 0.41 + 0.24 = 2.78$ minutes, allowed time for loading 100 board feet on bunks.

* * *

LB-2. Lumber 1¼" thick or over requiring seven cross-sticks.

Analysis (Note) Prefix "a" in front of operation symbol denotes two men working on floor. Prefix "b" in front of operation symbol denotes one man working on floor and one man working on bunk.

			Minutes
aB.	Place cross-sticks, two men on floor		0.32
bB.	Place cross-sticks, one man on floor and one man on bunk		0.65
aC.	Lifting board, two men on floor	(In section 1)	0.04
		(In section 2)	0.04
		(In section 3)	0.05
aD.	Place board and return, two men on floor	(In section 1)	0.04
		(In section 2)	0.05
		(In section 3)	0.06
bC.	Lifting board, one man on bunk, one man on floor	(In section 1)	0.05
		(In section 2)	0.07
		(In section 3)	0.10
bD.	Place board and return, one man on floor, one man on bunk	(In section 1)	0.06
		(In section 2)	0.07
		(In section 3)	0.08
K.	Punch time card		2.0
L.	Get up on bunk		1.0
P.	Place bunk		3.25

Data. Approximately 2600 board feet per bunk; 42 layers of 1¼-inch stock per bunk; 26 layers are piled with two men on floor; 16 layers are piled with one man on floor handling lumber, one man piling on bunk.

For aC and aD operations with boards placed in 1, 2, and 3 locations, we have:

Number of boards handled during timing	*Location of boards*	*Boards per layer*
18	1	2.57
15	2	2.14
16	3	2.29
		7.00

With an average of 7 boards per layer, there would be in 26 layers of Number 1 boards 2 x 2.57 = approximately 67
of Number 2 boards 26 x 2.14 = approximately 56
of Number 3 boards 26 x 2.9 = approximately 59

Average 182 boards

Time for aC-1, 67 x 0.04 = 2.01 minutes
aC-2, 56 x 0.04 = 2.24 minutes
aC-3, 59 x 0.05 = 2.95 minutes

7.2 minutes, complete time for aC operations on one bunk.

Time for aD-1, 67 x 0.04 = 2.68 minutes
aD-2, 56 x 0.05 = 2.80 minutes
aD-3, 59 x 0.06 = 3.54 minutes

8.02 minutes, complete time for aD operations on one bunk.

Timing the piling of 10 layers timed with one man on floor and one man on bunk, for B, C and D operations with board placed in Number 1, 2, and 3 locations we have:

Number of boards handled during timing	*Location of boards*	*Boards per layer*
28	1	2.8
24	2	2.4
29	3	2.9
	Average	8.1

With an average of 8.1 boards per layer, there would be
of Number 1 boards 16 x 2.8 = approximately 45
of Number 2 boards 16 x 2.8 = approximately 47
of Number 3 boards 16 x 2.9 = approximately 38

130 boards in 16 layers.

Time for bC-1, 45 x 0.05 = 2.25 minutes
bC-2, 47 x 0.07 = 3.29 minutes
bC-3, 38 x 0.10 = 3.80 minutes

9.34 minutes, complete time for bC operations on one bunk.

Time for bD-1, 45 x 0.06 = 2.70 minutes
bD-2, 47 x 0.07 = 3.29 minutes
bD-3, 38 x 0.08 = 3.04 minutes

9.03 minutes, complete time for bD operations on one bunk.

SYNTHESIS: T equals time in minutes to load 100 board feet on bunk.

26 AB equals time for placing cross sticks on 26 layers in "a" location.

$\frac{26\ AB}{26} = \frac{26 \times 0.32}{26} = 0.32$ minutes equals time per 100 board feet for placing cross sticks on layers in "a" location = r.

16 aB equals time for placing cross sticks on 16 layers in "b" location.

$\frac{16\ bB}{26} = \frac{16 \times 0.65}{26} = 0.4$ minutes equals time for placing cross sticks on layers in "b" location per 100 board feet = s.

7.2 minutes equals complete time for lifting boards into "a" location on one bunk.

$\frac{7.2}{26} = 0.277$ minutes equals actual time required per 100 board feet to lift boards into "a" location.

z equals per cent. allowance for rest and delays, lifting boards with two men on floor equals 20 per cent.

$1.z \times (.277 \text{ minutes}) = 1.20\ (.277 \text{ minutes}) = 0.332$ minutes equals allowed time per 100 board feet for lifting boards into "a" location $= t$.

8.02 minutes equals complete time per bunk for placing board into "a" location and returning.

$\frac{8.02}{26} = 0.308$ minutes equals time required per 100 board feet for placing boards into "a" location and returning equals v.

9.34 minutes equals complete time per bunk for lifting board into "b" location on the bunk.

$\frac{9.34}{26} = 0.346$ minutes equals time required per 100 board feet to lift boards into "b" location.

$z =$ per cent. allowance for rest and delays (one man handling) equals 37 per cent.

$1.z \times .346 = 1.37 \times .346$ minutes $= .474$ minutes equals allowed time per 100 board feet for placing boards into "b" location equals x.

9.03 minutes equals complete time per bunk for placing boards into "b" location for returning.

$\frac{9.03}{26} = 0.346$ minutes equals time allowed per 100 board feet for placing board into "b" location and returning equals y.

$\frac{K + L + P}{26} = \frac{2.0 + 1.0 + 3.25}{26} = 0.24$ minutes equals time per 100 board feet for making up bunk, punching time card, etc., equals p.

$T = t + s + l + v + x + y + p = 0.32 + 0.4 + 0.332 + 0.308 + 0.474 + 0.346 + 0.24 = 2.42$ minutes per 100 board feet.

Some one may say: "But what an expensive method to determine a task!" It took a skilled time-study man but a little over two days to observe, reason out, time-study and set the above task, at a cost of about $60. The factory in which this was done handles about two and one-half million feet of lumber per year. The net result was:

(a)The production was increased approximately 85 per cent.

(b) The pay of the operatives was increased approximately 32 per cent.

(c) The labor cost was reduced approximately 28 per cent.

(d) A net saving of approximately $400 annually was realized on the direct labor cost of this operation, for an investment of $60.

Therefore, I hold that careful scientific unit time study is applicable to and of real economic value in variable operations.

Accident Prevention Methods That Work

By William Lamkie

"CARELESSNESS of Mike Zabisco" as the cause of his serious injury is the reading of the works safety committee report on file somewhere in the works office. This is not the verdict of Mike's boss, but usually of an accident committee comprised of his fellow workmen who have been convinced by the preponderance of convincing evidence against him. But it is, however, of most vital interest to know that Mike and his kind are becoming less careless, even during these times of a greatly increased number of preventative measures in industry inaugurated for the purpose of maintaining the working force at maximum efficiency.

The fact is, for the first time Mike has been taught to see that it is within his power and responsibility to reduce to a minimum the hazards of his daily occupation. He discovered that somehow booze lessened his margin of safety the day after his holiday frolic and he banned the habit at least during his working hours. The management of his works has placed a premium on his reporting dangers and responds to any reasonable suggestion for providing safeguards. Posters, signs everywhere about the plant point out "BEWARE." The bulletin board notices are no longer littered with stale accident news notes, but circulars are replaced with fresh interesting matter as soon as the reading has gone the rounds of the works.

By this process of education the management has been able to show Mike how he loses most by his own carelessness and gains most by his own caution. There is good reason for him to believe that his thoughtlessness may cause his misfortune next. Sooner or later each enterprise will consider the greatest danger to safety as that workman who repeatedly passes heedlessly under the working crane, who operates the emery wheel without goggles, who wears soft soled shoes, who "monkeys" with the live electric wires he knows nothing about, and who does not report immediately for first aid treatment or examination in the case of a cut, bruise or some other physical disturbance.

With all the improved service facilities which the progressive industry now provides the workmen, the company has the right to forbid Mike or any other employee to sit unwashed and put into his stomach with his food particles of foreign substances which may in the course of time incapacitate him for efficient labor. Fortunately, the conditions have so improved in many works that employees taking foolhardy risks receive the severest condemnation of their fellow workmen. An employee in one of these shops was recently overheard saying to his pal who had failed to remove a loose barrel hoop, "Do you want our department to lose out in the accident contest by leaving that hoop for some poor guy to cut his hand on?"

The accident competition between works, departments and individuals in concerns where this preventive accident plan is used shows conclusively that most accidents are avoidable. The contest feature stimulates the interest that would otherwise be lacking, and furnishes additional incentives to precaution. In a recent instance the works winners in a contest among 20 plants, although operating to their fullest capacity in their history, reduced the accidents to less than one half what they were when the plant was running under normal pressure. The employees, the works safety committees and all those who participated, deserved the highest commendation, but the prize award did not compare with the benefit each individual employee in all the works in the contest received in having lessened the possible chance of workmen being incapacitated. The increased efficiency and elimination of causes for the numerous absentees during the period of the competition also repaid the management many fold for the substantial prices given the individuals, departments and works.

SPECIMEN ACCIDENT COMPETITION SCHEDULE POSTED CONSPICUOUSLY EVERY DAY

Department	Full time hours	Hours worked	Time lost hours	Percentage
Carpenters	334,878.75	334,740.5	148.25	99.95
Electricians	204,364	204,119	245	99.88
Machinists	175,883	175,503	320	99.82
Yard force	688,122	686,374	1748	99.75
Painters	118,325	118,005	320	99.73
Pipe fitters	134,530	133,960.5	569.5	99.58
Lead burners, etc..	156,199	155,501.5	697.5	99.55

Under New Management--The Manager

The New Era Executive Will Stand Out as A Man Among Men

By Charles M. Horton

This is the final article under the general heading "Under New Management" It turns to the human qualities of the industrial manager who will succeed in a large way in the immediate future; it claims for him the highest personal character; it pictures him as intensely human—in other words, a real leader of men who understands, and is in sympathy with them.

Mr. Charles M. Horton, *member of the American Society of Mechanical Engineers, was educated in the public schools of New York City and at the University of New Mexico. He served a drafting-room apprenticeship and has had twelve years' experience in designing special machinery. During a part of that period he was in the employ of the Westinghouse Machine Company, and was personal designer to Mr. George Westinghouse in the gas-engine division. As an avocation he has pursued literary work for many years, writing for both fiction and technical publications.*

RECENTLY I had occasion to go to New York. I spent a week in the town. I sometimes have typewriter trouble. Wandering about the streets of lower Manhattan one morning, I found myself passing a large agency conducted by the manufacturer that made my machine. Instantly I thought of my typewriter and also thought to get some information, and a part or two for my machine, if 'twere necessary. I turned and entered the establishment.

Inside a vestibule I was confronted by two doors, one on either hand. The door to my right opened upon a sort of retail sales room; the door to my left —both doors were of glass—revealed a long room nicely appointed, with men at desks, probably salesmen, and each set off from the other with low railings. I entered at this door and discovered myself in a beehive of industry, with machines clicking rapidly. and the far end of the room taken up with a number of private offices with ground glass doors and a string of telephone booths. The private offices evidently were occupied by the general sales manager and his immediate subordinates or assistants.

The Simon Legree's of industry are passing — progress be praised! Executives can no longer drive labor. Days of coöperation are here. Education has been a great factor in ushering in the new era, and the technical press has been a great instrument of enlightenment. The new manager is a man of education; he knows both men and books, as industrial managers as a class have never known them before. But more important still the manager recognizes in his workmen flesh of his own flesh, and blood of his own blood. He handles the obstreperous with kindness; the unproductive with sympathy and gentle guidance; and the dull witted with a parental protection that awakens while it protects.

As I approached the railing with a mild question on my lips, glancing expectantly from one to another of the gentlemen behind the railing, I received a shock. The door of one of the telephone booths swung open with a crash and out of the booth hurtled a man. I immediately judged him to be the manager of the establishment. He was perfectly attired, he was hatless, and groomed to the last least detail. His trousers hung perfectly; the set of his coat collar was neat and snug around his neck; the heels of his shoes absolutely square; enough of his cuffs appeared at the end of his coat sleeves—just enough; his hair was trimmed "featheredge" and correctly brushed and combed. In short, he was immaculate—in appearance a paragon. He emerged from the booth, talking as he came, and his voice. sharp and unpleasantly high, was biting off words. Also—and this was what gave me the shock he was snapping his fingers vigorously at somebody.

An Old Fashioned Bawling Out

"Hemingway, your call is here!" he said crisply, addressing a mild-faced individual seated at one of the desks in the salesroom. "Why do you not attend to your calls? Come—get in here!" He snapped his fingers some more. "You ask for a connection and then you run away! Come! Jump! The party is waiting!"

The mild-mannered salesman arose. His face was turkey-red. Hurriedly he swung open the gate and made for the booth. Presently he was lost inside.

The general manager, tall and straight as an arrow, lunged, still snapping his fingers, through a doorway, and was gone.

Myself, witnessing all this, did something the wisdom of which I do not know. It was a purely involuntary act upon my part, however. It was a hunch, a lead, a something probably no part of my thinking. At any rate, whatever made me do it, I can not say; but do it I did. I quietly turned upon my heel and walked out. Walking out, I denied that organization the profits on a retail sale amounting at the very least to fifteen cents. I suppose I was mad, and acted impulsively, but I couldn't help it.

The New Manager Will Not Rush

The New Manager will not be such a man. There will be no snapping of his fingers. The "rush" of business won't warrant it. There will be no rush, as a matter of fact. All will be calm and cool and collected under the new management. Business there will be, of course, and plenty of it. But also there will be something else. There will be personal efficiency of a character not taught to-day by efficiency schools. There will be a new sense of values—or an old sense of values revived. There will be a slowing down. A man will be effective as an agent of business because of what he will know about things other than business. The game will be a game, and not as it is to-day, a religion. There will be play, passive if not active, and all shall take part. The New Manager will see to it that all do. There will be no snapping of fingers; no sharp, imperious tones raised; no red-faced subordinates jumping at the crack of the managerial whip. All will be one; one will be all. And the New Manager will well recognize this, will know business for what it is—life in the living—and will enter into it honorably and justly and be honorably and justly a part of it.

There are a few such managers to-day. But they are the exception rather than the rule. And where you find these managers there you will find small establishments, with the manager a half—or, at least a part—owner. Such managers are part and parcel of small businesses. They are under no obligations to stockholders (men and women clear outside the work and thinking only of dividends, and therefore impatiently insistent upon results) and so have most to gain or most to lose through their methods of conducting the business. They are men who **know.** They are close to the things that count, and have learned the wisdom of being one with those around them, the men and women on their payroll. Therefore, they know that it pays immeasurably to consider persons and personalities if the business would prosper. The business does prosper—I have yet to see one wherein the humanities were recognized that didn't. Workmen will toil their fingers off for such business managers in the cause of such business interest. It is the man or family sitting back and cutting coupons that "gets" the labor world and rouses the envy of the workers.

The Manager of the Dumbar Company

The Dumbar Manufacturing Company was such a concern, and the manager of it was such a manager. He was essentially human. He was one of two partners, and the business was their own. The concern was located in a far Western city, whither both these men had been compelled to go, after leaving college, on account of ill health. Perhaps it was this early misfortune which made them lenient of the frailties among their men. Misfortunes will do that, you know. Misfortunes have a way of enlarging our sympathies, and sympathy is the mother of intervention. At any rate, these two men came, separately and unknown one to the other, to this Western town, finally met and became acquainted, and eventually established themselves in an engineering business, they both being graduate engineers. The business prospered from the jump

I do not exaggerate when I say that these men, and especially one of them, the manager, smiled at losses in their plant due to ignorance or carelessness on the part of their help. They—and especially this manager—seemed to recognize the workings of the natural law, to the effect that no loss is without its gain. Nor is it. Sunshine will follow rain just so surely as daylight follows dark. Nature provides. Nature provided here. I myself witnessed the provision more than once, I myself at one time having worked for these people. Whenever a machinist spoiled a piece of steel, which necessitated the piece being discarded, I have seen more than once a customer enter the plant with a drawing or a sketch which called for a part the making of which was possible out of the discarded piece of metal. It does not always work out thus directly; but it works out in some fashion. Nature provides. Recognizing this great truth, these men seemed to know that, after all, nothing matters. Nor does it. Though it has been frequently said that one must live in the West to find this out.

Patience and Prosperity

These men were patient in all things. And they prospered. Of course, they ran into hard times, as do all concerns at one time or another, and one of these periods came upon them in the panic of 1907. We all remember the day and year. Clearing-house certificates were issued and money was scarce and hard to lay hands upon, and labor was turned loose. That is, it was turned loose from the majority of industries. But these men proved themselves the exception in this as in other things. They kept their organization, though it was a small one, intact. They fired nobody. It probably entailed financial suffering on their part; but they stuck to their guns. And note now what happened. In this period of depression they turned to the development of a special machine for the mining interests, and lo! when the clouds lifted they sold every machine they had built and were ready to deliver orders over and against their competitors. The law had worked again. They had lost nothing, though at the time it looked like mighty poor business on their part to retain all their help. This thing of recognizing humanity surely pays in the long run.

The Manager Must Know the Humanities

The New Manager will be such a man. He will be large in the humanities. His interests won't be lopsided. He will be fair to the sources of his income—capital on the one side and labor on the other. He will be equally fair and just to both, nor hold secret leanings in either direction. He will be a man of parts. He will be a man of bottom. He will fight for the interests of labor as strongly as he will fight for the interests of capital. There will be no smiling behind lifted hands; no bushwacking; no playing to the galleries; no kowtowing to the gods. He will recognize the absolutism of mankind, and be it represented by capital or labor, will yet recognize it. This is not so to-day.

The average manager is a growth; one who forged his way upward, if not by riding roughshod over the heads of his brothers at toil, at least through a more or less ruthless inconsideration of the rights of these brothers in toil. He has won the mastery through a willful, dominant desire to master. And he has got what he set out after, because we all get what we set out after. He has won to managerial estate. In the winning—in the assertion of himself over and against his kind—he has lost sight of essentials—the needs, the rights, of mankind as a whole. Therefore, he is unfit to rule because he has lost all sense of proportion, of the perspective of those whom he would rule over. In this, too, in this man, nature has well taken care of her laws.

How I Would Choose an Executive

If I were the owner of an enterprise, and one day found myself in need of a foreman, or a superintendent, or a manager, I should do but one thing. I should not try to take away from some other organization a man whose reputation was such as to make him desirable to me. Nor should I cause to be inserted in a magazine or a newspaper an advertisement asking for the services of such a man. Nor should I cast my eye over the possible timber in my plant for a man whose work and length of service made him a fitting candidate in my estimation for the opening. Personally I should do none of these things.

Instead, finding it incumbent upon me to get a man for such an opening, I would post the opportunity upon the organization's bulletin board; set a day for the election; hold a caucus in due season with all the men on my payroll assembled; and have one or several nominees selected from out my organization. Then I should hold a regular election, with everybody voting, from the boys serving apprenticeships and the girls hammering typewriters, up to and including the owner himself, meaning me—with no more power to my vote than that carried by the office boy's—and thus find and secure my man for the vacancy. Not only this. I should provide for a referendum and recall, should the elected man prove incompetent—and hold another election. The election, understand, would be the thing. It would be my way of chosing heads and officers for my several departments, even up to my manager.

I feel that such a method would bring results such as no other method in vogue to-day can. The fairness of it would appeal to the workmen, who, once having elected their man, would stick by him in fair weather and in foul, just as good party followers to-day stick to their chosen among men even when these chosen ones take stands politically out of keeping with their own precious opinions.

As a nation, we are like that. We stick by what we do or say, however the outcome may prove good or bad. There are many secret soreheads to-day who voted for President Wilson because they believed he would not declare war. Now that he has declared war, however—though themselves secretly sore—they are with him to the hilt. As I say, we are like that.

An organization electing its superintendent, or foreman, or general manager, from out its own ranks—and personally I should feel no qualms if my assistant foreman in the machine shop were elected to the general managership—would stick to that man though the heavens fall. As a joker, the referendum and recall would take care of incompetents thus hoisted into power. But before pulling the man down, I should once more go to my employees and place the situation fairly before them. And I believe I should abide by their aggregate decision in this, too.

As an experiment, the thing itself would bring out its weaknesses and strengths. At any rate, that is how I should select my new manager, if so be I needed a manager or any one of my executives. Such a man would hold great power over the men —else it would not be possible for him to get elected. In the exercise of this power he would prove a valuable man in my organization. Of that I have no doubt whatever.

What Personality Means

Working folk are quick to sense a personality. They do not have to be brought into immediate relations with an executive to fairly size up the man. It comes to them in many subtle ways. Sometimes they judge a man correctly by a fleeting first sight of him as he walks through their department. Again it comes to them out of letters, department instructions which from time to time he issues and signs. A voice over the telephone often indicates to a person quick to sense such things the broad character—at least, characteristics—of the man. Labor is ever on the alert for these things, and, being so, becomes proficient in judging. And these things travel in a shop. The word passes along, dropped here and there as an aside in conversation, and thus the whole organization, down to the lowliest Wop helper, likes or does not like the man holding the reins, even though this man is rarely seen in the shop. And thus the organization as a unit gains the approval or the disapproval of labor as a whole; as a community.

Characteristics of the New Manager

The New Manager—to repeat—will be large in the humanities. He will be a man of broad general sympathies. He will be a man of generous imagination. He will be a man, preferably, who has known toil with his hands; this to help his imagination, to give virility to his sympathies. Having sympathies, and exercising them freely, he cannot but be just in all things. He will take his stand, and hand down his decisions from the only viewpoint worth while—Truth. It is the only safe stand.

Often times men, confronted by a problem necessitating immediate decision, find themselves, owing to the complexity of the problem and the many rules governing success in life and business, unable to decide. That is natural. Yet it need not long puzzle any man. If he will but take the stand of Truth as set forth clearly in every part of nature, he will get his answer. It will blaze up and sear his mind's eye to the utter annihilation of all other thoughts. He will know what to do, to decide, without hesitancy, for there will be but the one answer. Truth will tell him what that answer is. He will make the decision. Making the decision, he will be right as much as any man would be right, and no man could do more. Thus he has played safe. There can be no just criticism of his attitude, because, by his very stand, he has taken an attitude which cannot be improved upon, for the reason that nature, the basis of his decision, cannot be improved upon.

The New Manager's Life

The New Manager will live clean. His private life will be above reproach. There will be no wine in his veins, no superfluous, adipose tissue covering his stomach. The animal in him, as revealed in these things, which of themselves reveal gormand instincts, will be conspicuous by their absence. The world is becoming less patient with men of animal tendencies. It will become more so as time goes on. Booze has no place in our scheme of things. It took us a sad, long time to learn this, however, because we could not forget the old log rollings of our ancestors, who believed that the logs could not be rolled without a jug of whiskey on the ground somewhere. There was method in this madness, though. Given enough of the stuff, and the rollers became themselves the logs, with the actual logs rearing upon hind legs and doing the work of the rollers. It was part of the game, a game in which all revelled, logs and loggers. To-day we know better. We are learning slowly, but we nevertheless are learning, year by year.

The New Manager's Judgment

The New Manager will be a keen judge of nature. He will be this by divine right. For such men are born, not made. It comes of abnormal powers of observation. Some men there are who see; some who do not see. We have men who go through life on their ears, as it were, and men who go through life on their eyes. Mechanics generally are of the latter. Let them see you do a thing once and they will do it after you. Tell them how it ought to be done, and you and the student both out of the laboratory, and though you grow hoarse with explaining, the thing will yet remain undone. The New Manager will be a man with an eye. He will be a shrewd observer. He will observe instinctively, without conscious effort on his part. It will be a function of his being, as natural and as involuntary as his breathing. Thus he will see and judge and know and learn.

Men who look alike, or talk alike, or walk alike, or play alike, will, in the broader aspects, be alike. This is the principle governing the reading of character. A natural observer will remember a man's appearance as much as he will remember the outstanding features of his character. The two will be stored up together somewhere in some inner recess of his brain. Years later, or perhaps only months, across his path will step a man whose appearance will awaken in his brain, these stored-up observations, first the one and then the other, and the facts themselves will be automatically released. Thus at first glance the natural observer will know in fair measure the characteristics of the man crossing his path.

The rule is not infallible; there is always much come and go in the thing, owing to certain characteristics which have bearing upon certain other characteristics. But as a general rule the above holds true, and it is the rule by which men judge men, whether they know it or not. The New Manager, by reason of his powers of involuntary observation, will be a judge of men, and for the reason established here. This will make him proficient in his work.

The New Manager Will Not Bluff

There will be no bluff, no austerity, and but very little dignity in the New Manager. I wish to emphasize that. We need not explain the need for absence of falsity in the New Manager—the thing explains itself. As a people we are not bluffs, although the world beyond our doorstep for years has entertained this opinion of us. But the thing is error. Americans—true Americans—do not bluff. They don't have to bluff. They know what they know, and are proud and glad to give it utterance and also freedom of physical expression. Similarly true Americans are quicker to ask sincere questions, thus revealing the fact that they do not know all things, than any other race of people on the globe. So there is no reason to explain the desire for absence of bluff in the New Manager.

There is some ground for explanation as to the other two qualities, however—austerity and dignity. The one goes hand in hand with the other. Each in a way is close-bordering upon bluff, and therefore has no place in a true democracy. Men of genius are notoriously men of little dignity and no austerity. They are easily approached; are found to be unaffected when approached; give way to utterances the simplicity of which amazes. Dignity is a shield behind which men draw for protection, lacking the moral courage to be truly themselves.

Sometimes, however, dignity is the result of close breeding, a false fostering in the young of a sense of aloofness and privacy from the common herd on the part of parents. This in a man is to be pitied. So reared, he himself is not to blame. Of such a man we do not deal here. It is the individual of austere and haughty and dignified demeanor by his own selection whom we shall cease to nominate for the position of the New Manager. We do not want unapproachable men in this responsible position. We prefer our executives from among men who are not afraid to come out in the open, to be a democrat among democrats in the industrial world, men of sure grip upon themselves, and who know men sufficiently well to be glad to intermingle with them, and to be as one with them on all occasions. Dignity—calm, cold, unruffled dignity—prevents this. The man himself may appeal. But the appeal is one only of the flesh. The spirit is absent. It is held aloof. Labor is quick to sense this, and feels ill at ease in such a presence. No such feeling is desirable to the New Manager. His very success depends upon a feeling of common interest and beliefs. Lacking this—cut off from it by dignity and austerity—the New Manager will fail.

The New Manager's Picture

There you have a physical and spiritual picture of the New Manager. He will be all these things and more, along the same general lines of truth. He will be a man of large vision—knowing much more than the exigencies of his position demand—knowing, too, the value of this other knowledge in the competent carrying on of the duties of his office. He won't be as wise as Homer—he need not be. But he will be infinitely wise in the workings—thoughts, hopes, beliefs—of the laboring man's mind. He will be this because he will be one of these men. And always his generous vision will permit him to bring to bear upon a given situation arising in the conducting of the organization's productive affairs a mind clear as a bell on the true relationship of these men to himself, of these men to themselves, of these men to the powers that make possible a liberty of expression, of movement, of thinking, second to no other power or group of powers upon the earth. That will be his viewpoint, his stand, his attitude. He will be a man among men.

When we have said this we have said all.

The United States Shipping Board Emergency Fleet Corporation has established a rule that any piece-work rate set by any shipbuilder must stay in force during the period of the war. The controversies between employers and employees over the question of piece-work have been most serious and the employers in many cases have been chiefly to blame. Any manufacturer, whether he be a producer of coal or any other commodity, who sets a piece-work rate, finds he has made a mistake and then reduces that rate is doing a great injustice to the workman. A piece-work rate set a manager, superintendent, or foreman, is a contract that should be kept in force for at least one year. Furthermore, if this piece-work rate is on a particular machine, and the man or the operator should leave or be dismissed, the man who succeeds him should receive the same rate. A law passed by the government making it compulsory for a piece-work rate to remain in force for a given time would be helpful to labor and industry.

Profits are not all, however. No man can know whether his organization is really efficient unless he knows his costs and unless he has some standard of costs, either the average for his field or the figures of the lowest producer which he can use to compare with his own.—*Edward N. Hurley*

The Spirit of the Organization

To Create This Spirit We Must Begin at the Top, for the Keymen of the Shop Are the Executives

By William Judson Kibby

The industrial organization that is to forge ahead from success to success must have an executive leader with high ideals, a desire for fairplay and an active willingness to help his fellows. These same ideals must also be transferred to all the other executives, including all of the foremen, for the latter reflect the management to the workmen. This article shows something of how all this can be done.

Mr. William J. Kibby *is an industrial psychologist. For some five years following 1906 he was president and general manager of the Space Saving Appliance Company. For two years,* 1911-13, *he was an organizer for the Sheldon School in New York City, teaching and advising sales organization. For the past five years he has been an industrial counselor, dealing particularly with human relations in industry. His work has been confined to the principal executives down to and including the grade of foreman. During this period he has had among his clients the General Electric Co., Diamond Match Co., The Firestone Co., Taylor Instrument Co., Miller Rubber Co., and the United States Government Defense plant. At the present time he is director of the Department of Personnel Development of C. E. Knoeppel & Company, Incorporated.*

Creating the Spirit of the Organization

If we are to create the spirit of the organization we must start at the top, for in most cases the sorrows, as well as joys, at the bottom are only a reflection of the top.

One of the hopeful signs resulting from the present day trend is the tendency on the part of the executive head, or heads, to come down to an even plane with the rank and file of men, a disposition to reason rather than rule, and happy (from an industrial viewpoint) is that executive who realizes this fundamental need of gathering close to his side the men who must go into the front line trench of human engineering, for the real executive today is a human engineer—he knows men, and his every act shows his untiring interest in them.

The industrial head in the past has been concerned with building plants, financing and manufacturing materials, and in proportion has given very little time and study to the individual unit.

On account of the wonderful industrial growth of this country it has been necessary for plants and materials to have a large place in the mind of the executive head. It is true that there are splendid examples of exceptions, but in the main this statement is true.

Business Building is Man Building

The truth of the saying that "business building is man building" was never more apparent than today, for we now realize to the full the value of man power, and as a result of this great war we will very likely never let materials consume the major portion of our thoughts. From now on, and for many decades, we will be ceaseless in our endeavor to create an organization.

Only too often there has not been the right man between the executive (one imbued with the correct attitude) and his men in the shop. This has resulted in his will and ideals never being realized among his dependents.

There are hundreds—yes, thousands—of plants where the rule of the iron will exists, where men and women know only to work (they have never known other than fear) and yet, to talk with many of the executives of these concerns one would be led to believe that they were in full accord with the spirit of kindness, fair play and justice, when, as a matter of fact, deep down in their consciousness they laugh and call this sort of policy "soft stuff," and chuckle at the foolish policy of "come on, boys." In such institutions fear is deep-rooted and, as a rule, it means a dwarfed mind or the storing of class hatred which is showing itself today in boldest fashion. To a large extent this kind of executive has brought about this condition, or at least has made a large contribution to the net result.

A policy of this kind does a grave wrong to organized industry, for it spreads to plants where justice rules and disturbs quiet, contented minds with poison so subtle that it catches and spreads again.

It is a commercial and industrial crime, for it kills initiative; it kills interest in work; it kills the greatest human need—*the incentive*—for few men there are in the industrial field who realize that each of us must have some sort of incentive, for without it we either go backward or find paths of wrong reasoning.

That institution which is radiant with sunshine, happiness and justice, reaps the reward of steady, fearless service, for it is only in such plants that we find "The Spirit of the Organization," open-minded and amenable to suggestion for the good of the institution.

The Spirit Comes From the Top

It is exceedingly hard for the superintendent, department heads and foremen to generate the right spirit in most cases unless the head itself is active in coöperating and shows personal and sincere interest. For any other but sincere interest is easily detected, and it is better for the head to keep away from his people unless he is really sincere in his desire to aid them.

The large financial institutions have been loaning money in the past based upon appraisal of plant and balance sheet, but of recent years they have arrived at the conclusion that after all there were too many losses due to a third factor which had almost been lost sight of—the organization—and so we find them more interested today than ever before as to whether or not there is back of this plant and balance sheet a well-rounded out "star team" and not a "team of stars." Is it a one man organization, dominated and ruled by him? Or, is it an organization where there is a full division of authority and responsibility placed upon men who are capable of discharging with a high degree of intelligence each task that is given? And even more, are they working together? Have they the "spirit of the organization?"

Getting Men to Think

The superintendent of a large corporation was heard to say recently that even he had never thought that he was expected to get his men to think. He had been so instructed and handled that there was only one thing for him to think about and that was, "How much tonnage can you get out today?" He had never been taught to *get together* his pivotal men and talk it over. All his life he had been schooled to "get the stuff out." After a careful study of this man it was found that he was easily molded into a wonderful coördinator because his mind was right. In saying "right" we mean that he "loved his fellows," and they thought the world of him. (Let me say right here that there is not going to be even standing room for the old school type of superintendent and foreman after this war is over, for we will have arrived at a higher plane of human intelligence and, first of all, men will not stand for it, and in the second place, they will not need it.)

What we need is the spirit exhibited by the president of one of our largest manufacturing concerns with plants located all over our country. When confronted with the fact that a certain chemical could no longer be had, one necessary to his business, he selected three young men (none of whom was a graduate chemist) and placed each upon a separate search, not knowing that another was trying to solve the same problem, worked each separately for a few months under his wonderful encourment and enthusiasm, and at the end there were three discoveries, each one equally as valuable as a substitute.

Asset of Latent Possibilities

The latent possibilities lying dormant in the path of the human engineer (for surely that is what every really great executive is) constitute the largest asset of future development so far as building a well-functioning organization is concerned. The solution of the great industrial or labor problem is a matter of the right kind of men as executives and imbued with the right spirit. The coming executive must be a teacher. He must teach his department heads and foremen that in the rule of reason is positively the only solution of the sorrows between so-called capital and labor.

The coming crop of workmen must be taught to think right and to think with the employer and not apart from him. Their interests are one and inseparable. This teaching must be done by following plans carefully worked out and executed by men who love and know men. The organization must live up to the ideal laid down by its executive head, and may heaven protect that executive who has no ideal, for he is going to have a hard row to hoe without them, for "it's in the air" and it is useless to try to get away from it.

A Recent Experience

The head of a large corporation in Rochester was seated with his foreman one evening recently at a regular monthly dinner, singing songs and entering into the meeting as heartily as any one present, and with the greatest possible sincerity he said, "This is one of the happiest moments to me to realize that these men are happy and contented, they realize that I am doing all I can to give them a living wage and a good happy place to work in during their wakeful hours." When he arose to speak the look of profound respect was magical, and when he had finished they gave him a glad, joyous round of applause which left no one in doubt as to the loyalty they held toward him.

If we are to fathom this great industrial unrest we must do it through reason. Some of us have only too often forgotten the laws of *compensation* and *habit*.

Militant domination in the factory makes ill-feeling and fosters fear and hate, while correct reasoning and fair treatment as a basis for education will win.

An Ounce of Firm Kindness is Worth a Ton of Explosive Arguments

At a meeting of foremen in a large institution a foreman who had never contributed a single idea to the improvement of the product or organization came up to the superintendent in a very simple manner and made a suggestion which, when ultimately worked out, will mean a saving of many thousands of dollars per year. The rewards for persistent effort in getting men together and talking over problems and exchange of ideas is a growing field, now being used to great advantage.

The president of one of America's foremost manufacturers traveled almost half across the country monthly for several months to attend a foremen's meeting, not taking any active part, but rather to join the spirit and thereby show his interest by meeting his men at first hand, even to calling most of them by name. In such an institution foremen do not change often, and yet this big man will not talk outside about what he is doing for his people, saying that it is too sacred a thing to advertise. How unlike another large corporation that takes particular pains to let the public know exactly what it is doing in the way of welfare work!

Spirit Shows in Life and Action

We get the return in kind and the building of a well-rounded, balanced organization is the result of hard, long self-sacrifice on the part of certain executives who give of their own life by being a living example of the kind of co-workers they would have their men down the line become.

One of the high executives in the largest kodak company recently said that he came to realize only of recent years that his foremen were the men who were making or breaking the company. Since realizing this fact he had organized and strengthened the unity of purpose and friendly interest of his great body of minor executives.

As a group there is no class of men so important and yet so utterly neglected as the foremen, and no field so boundless in possibilities of usefulness as the foremen.

They are the men who meet the great mass of men in our factories; they are making and breaking men every day. The labor turnover is largely (in normal times) a responsibility of these men, and even today a large percentage of the body of floating workers is due to the lack of willingness to train, teach and handle. "Hire and fire" is their common routine as it is far the easiest method of handling the situation, and not having been imbued with the right spirit and patience, they go on from a state of lack of interest to final disgust, and then comes the "don't care" stage where we find countless thousands of foremen who do not really realize this.

Willingness To Get Together

At a recent meeting of foremen in a large plant they remained on their own initiative for an hour and a half after the regular scheduled program had been completed, talking over various problems which they encountered daily, a thing which the president acknowledged could not have been done without having gotten the men together on a mutual basis.

Foremen must be brought together and taught fundamentals of organization, taught the value of correct supervision and imbued with the spirit to give and take and forget their own little petty trials.

This kind of education becomes a part of their thinking and when we get foremen to thinking, and thinking most of all with the firm, we have gone a long way toward reaching the men on the firing line, for the foremen when dealing with workman will as a natural consequence deal out to these men the ideas and ideals they have been thinking over. In fact they are now doing so but, sad to say, they are only too often half heartedly defending the management.

The men who handle our workmen should be instilled with right thoughts, for a man's thoughts form his code of living and therefore his procedure.

World Need for Economy in Industry

Every Industrial Waste and Extravagance is Making the Great War Cost More Than it Should

By W. Rockwood Conover

Under the headings of industrial organization, industrial management, factory production, purchasing, receiving and shipping, power production and labor the author forcefully points to wastes and losses that must be eliminated if we are to win the fight for our nation's life. The article is a clear call to save and conserve on every side of our manufacturing efforts.

Mr. W. Rockwood Conover *has been connected with the General Electric Company for 26 years on economic work; during the last 14 years of this period he has been the industrial economist of the Schenectady plant. He is a frequent contributor to* INDUSTRIAL MANAGEMENT, *and other journals comprising the technical press on industrial economics and kindred subjects.*

INDUSTRY is universally recognized as the natural foundation of human existence. It is thus both historically and coincidentally the economic basis of the state and of our national government. Nearly all human endeavor is measured by the visible evidences of material benefit derived from organized forms of productive labor. In time of peace industrial enterprise is an essential element in the development of the race, the upbuilding and growth of communities, the establishment of order, stability and permanency of both state and national governments and in the conduct of private life. In time of conflict it becomes a vitally important factor in equipping and sustaining armies in the field, and the indispensable source of maintenance of the engines of war.

Extravagance and waste and inefficiency have heretofore been nearly universal. Nowhere has accumulated wealth and invested capital attained a full measure of success commensurate with the possibilities involved, or produced results representing 100 per cent. utility of employed equipment and facilities. Large resources have been devoted to industrial enterprise only to demonstrate that net earnings are not comparable with initial expenditures, and nowhere do we obtain the full benefit of human effort or the largest output from the consumption of labor and material.

It is imperative during these years of world-wide war and disorganization of the normal functions of business that every industrial operation and effort should be upon a much higher scale of efficiency and economy than ever before. For the higher the effectiveness of industry the greater will be the fighting power of the government and peoples, and the more helpful will be the support and relief during the period of universal distress. It is essential that every manufacturer and industrial manager start anew the process of investigation and analysis to determine where he stands along the competitive scale of productive efficiency.

Many industries are handicapped by high manufacturing costs through failure to establish proper systems of economic control in all the functions of industrial operation. In many industrial plants there is evident a large degree of inefficiency and waste, coincident with which there usually exists a lack of coördination and coöperation in the functions of management and factory supervision. Losses and delays in production occure because of incorrect or incomplete designing, improper and inadequate distribution and supply of tools and materials to the shop, incomplete drawings and instructions to the workmen, and lack of care in authorizing and following out production schedules. Add to these defective equipment, unsanitary shop conditions and lack of interest in the individual, and we have the chief explanation of the universal decreased effectiveness of human endeavor and the inevitable curtailment of the volume of industrial product. Statements of the ratio between capacity and accomplishment in industrial undertaking are sometimes exaggerated and pessimistic, but one need not look far to perceive that too large a factor of the world's labor is expended in consumption of man power and energy without a satisfactory commensurate return.

INDUSTRIAL ORGANIZATION

The organization of industrial undertakings will doubtless have to be developed along new lines. Industries will need to be established for more definite and specific purposes. The plans for founding new business or building new factories must give greater consideration to a proper differentiation between that portion of the product or apparatus which it is desirable to manufacture at the home assembly plant, and those parts or details which can be purchased with greater economic advantage from outside concerns engaged in production of small parts. Because of this fact it will be necessary to analyze more exhaustively the principal phases of proposed organization and all acts relating to the founding of a new industry in the beginning, in order to proceed with fully defined plans in reference to the nature and extent of equipment required, layout and construction of departments and buildings, and the spaces to be allotted to receiving, shipping, storage, etc.

INDUSTRIAL MANAGEMENT

The advanced principles of management and supervision must receive a new degree of attention and more scientific thought and study be given to the subject of coördination and coöperation of executive and productive forces. Greater concentration of authority and of all official acts, the elimination of repetition and duplication of directive effort, and the establishment of higher standards of operation involving greater speed and precision and greater finality in all the rules of shop practice will be essential.

THE WORK OF DESIGNING

Our engineering and designing work will need to be more constructive, more final in its application to shop processes. The experimental stage of new designs will have to be wrought out and completed in a field or department by itself. The new order of things and the rapidity with which a new invention of public or private utility must be put into production will render imperative a greater degree of completeness and refinement in design than has heretofore been realized. When the shop starts work it must be with well defined plans and instructions, with no stoppage of productive process through uncertainty or lack of information.

Production Routine

In the organization of production routine there must be a broader and more intimate knowledge of shop conditions, in order that the movement of materials in rapid progressive order and sequence of operations may be provided for, and the bringing of separate details to the assembly floor accomplished with regularity and certainty. This will involve a more extended analysis of both human labor and shop equipment, a rearrangement frequently of men and machine tools, in order to systematize movements and secure greater precision of actions both manual and mechanical. It will involve a greater refinement of shop processes, the substitution of modern tools for old, of machine performance for manual tasks, and a general speeding up of all operations in effective unison of effort toward a common end. The old methods of handling production must be eliminated from present industrial establishments and the progressive shop of the future. The distribution of tools and materials, instituting schedules of output, or providing the workman with drawings and instructions, must be with such accuracy and promptness of service as shall render the application of all directive effort to manufacturing processes complete.

Purchasing Stocks

The purchasing department has a new and added burden and a more difficult task to perform brought about by the world war. Many new problems are involved in obtaining the factory's supply of raw materials which did not exist three years ago. With increased cost of metals and fabrics other influences have combined to make the work of the purchasing agent hard and often impossible of result. Congestion and delays in transportation, requisitions and embargoes by the government, increasing consumption and demand in every part of the world, all tend to render the obtaining of stocks more and more a matter of uncertainty and often one of mere speculation. With these increasing difficulties greater effort must be made, not only to find new available sources of supply, but to conserve and save in the purchase and use of everything required by the shop. System of control must be set up in every department and rigid rules of economy established which shall make impossible the improper employment or destruction of anything of inherent value. This will involve the instituting of new methods of procedure in most factories, for as a nation and as individuals we have not yet taught ourselves the full lesson of economy either in the administration of government or of industrial enterprise. We are predisposed to extravagance and waste, to inordinate desire to have everything in abundance, to the consumption of many material things which cannot be demonstrated to be of essential value to either our physical well being or our mental advancement and growth. Not only productive stocks but expense supplies and materials for maintenance of equipment and for the prosecution of daily office and shop routine must receive greater attention than in the past, and new practices established which will limit and conserve the use of these materials within the bounds of carefully regulated and scheduled manufacturing requirements.

Power Production

The production of power, heat, and light is a field demanding special attention at the present time. It offers new opportunity for vast improvements in the type and character of installations, and a larger degree of economy in operation. The present fuel shortage lays new emphasis upon the need for more investigation and study on the part of manufacturers and managers into the cost of electrical energy and of steam for heating and manufacturing purposes. New stations will have to be built and extensions planned to provide for large increases in generating capacity. The old equipment of engines and boilers must be rapidly superseded by modern apparatus before power can take its proper place among other functions of industry already engaged in the conservation and building up of the world's resources. There must be immediate recognition of the need for more efficient installations from year to year and more scientific methods of operation.

Conserving Industrial Wastes

Conservation of by-products and waste is now forcibly brought to the world's attention by the exigencies of the great struggle going on. There now exists a paramount necessity to save everything of inherent value which cannot be ignored or gainsaid. It is becoming pressingly evident that we must reorganize our present practices in business and manufacturing to meet the new conditions or suffer ignominous defeat. The gigantic strides of industry, the growth of new communities, the wealth of big cities, and the world-wide demand for products, have all tended to develop a confidence in abounding resources and a habit of wastefulness in production. This tendency has been conspicuous in the building and operation of railroads, but it is also evident in the operation of manufacturing plants as well. Contiguous areas between shops, as well as factory floors and store rooms show accumulations of metals and other materials left over from productive processes or from the work of maintenance and repairs.

Human Labor

The factor of human labor has assumed a new and most important place in all industrial operations. During the present world conflict its importance has multiplied a thousand fold. Neither the work of private industry nor the manufacture of materials for war can be carried on without the coöperation of the individual and of skilled labor as a class. Every productive process is dependent directly or indirectly upon the constant application of human energy, mental or physical. Now, as never before in the world's history, nations and governments are looking to industry to do the greater share in the world's fight for peace. And what does it all mean? It means that man power at home is as big as man power in the trench. It means that economy of effort and precision in action are as important in the factory as science and discipline on the field of battle.

It is essential that the highest accomplishments possible of attainment shall be realized in all industrial enterprise. The call is to industry. If we are to attain the freedom of the world it must be through a higher refinement of man power—a fuller degree of perfection in manual and mechanical art. Systems of control must be set up in every factory in the land, analyses of all manufacturing and of official and directive functions.

Milwaukee's Organization for War

Trying Out the General Staff Idea in an Industrial City

By Willits Pollock

Executive Secretary, Milwaukee County Council of Defense

At the outbreak of war Milwaukee County, Wisconsin, established a dual committee system which surveyed every industry in the county, developed organizations for all industrial and community activities, and has most effectively knitted together the entire efforts of the county for winning the war. Quite recently the War Industries Board has taken up a plan for district control of war industries. The Milwaukee plan deserves to be carefully studied in connection with this national movement, which appears to be making considerable headway, and it shows how district control can be obtained and utilized to the fullest extent.

IF America and her allies fail to win the war and imperialistic Germany succeeds in securing an indecisive peace, there will be just one basic cause—the failure of democratic society to foster the growth of the "general staff idea" in public administration. America and her allies in general, but America in particular, have failed up to this time to develop the general staff, the planning department, or the department of general administration, whatever it may be termed. We have denounced planning as theory and waste, but it is merely practical.

The idea is one which goes deeper than that of an autocratic centralized military command. It applies not only to the nation but to the state, the agricultural district and to the city. Each urban unit and each farming district can have its all embracing organization, its general staff and planning department, and, what is more, America is commencing to realize it through the movement for the creation of councils of defense, war service committees, and the extension of the programs of chambers of commerce. The plan of the City of Milwaukee is probably unique among these movements.

Milwaukee entered the war under perhaps more peculiar circumstances than any other urban district in the country. A large foreign population, a well organized Socialist party and a strong working class movement combined to make more difficult the problem the country was facing. The old Revolutionary flag of "Unite or Die" was as appropriate for Milwaukee as it was in the American Revolution. Fortunately a strong, compact and able body of Milwaukee men at the very first took up the question of unity, and under the law created by the State Legislature joined with the State Council of Defense in perfecting a war organization for Milwaukee County. These local councils presupposed what amounts to a coalition (for each district) and, in the case of the Milwaukee organization, this actually was effected.

Manufacturers, labor men, politicians, bankers, city and county officers, Socialists, Republicans and Democrats, all joined to perfect the Milwaukee County Council of Defense. It was a strange set of bedfellows. Milwaukee literally threw everything into the pot and organized under this controlling body all of her resources, public and private.

A program was adopted which literally meant that Milwaukee was to organize:

1. To aid the Government by meeting all demands for men, money and materials.
2. To operate the productive machinery at maximum efficiency.
3. To mitigate the effects of war upon the civilian population of the district and to make wartime changes as easy as possible.

In effect, the theory upon which the Council of Defense in Milwaukee has been organized is that of a general staff whose chief duty is to plan, harmonize and organize, working through existing organizations where possible, and creating new machinery where this is necessary. The results of the first year's work have been the organization of over 500 committees, the enrollment of a force of 8,000 volunteer workers, and the mobilization of the existing governmental machinery of the city, county, the various commercial associations and other bodies.

Milwaukee Resources Classified Under Departments

The entire system of organization is based upon the organization of Milwaukee resources under five departments, each controlled by a departmental committee composed of leading citizens of Milwaukee, and each department manned by a staff of administrators, secretaries and assistants, all reporting centrally to the Administration Committee, the executive secretary of which is the active head of the daily routine of the organization.

1. Department of Administration, controlling the staff functions, such as general administration, transportation, public safety, labor and employment.
2. Department of Manufactures, controlling manufacturing enterprises.
3. Department of Commerce and Finance, controlling distributive and financial businesses largely through existing associations and organizations.
4. Public Welfare, controlling businesses and agencies providing food, fuel, medical attendance and social service to the community.
5. Department of Public Affairs, controlling educational and patriotic work or the mobilization of the morale of the district.

As may be judged from the widespread character of the work, the Milwaukee Council of Defense has literally taken over the essential parts of a strong industrial program, commercial economy, transportation, and labor programs, and the essential parts of a broad constructive plan of public welfare. It is a singular individual who is not vitally interested in one or other phase of the program.

Department of Manufacture Handles Industrial Problems

It is impossible in the space allotted here to do more than barely outline the organization, any one of a dozen of whose elements presents an interesting chapter. The utilization of Milwaukee's industries, for instance, for the best interests of the Government, has been carefully studied. Labor turnover has been watched in the various trades, and incidentally 70 per cent of Milwaukee's immense industrial capacity is engaged in Government work. The Council of Defense maintains an Industrial Bureau at Washington for the purpose of connecting Milwaukee's industries with the 300 widely scattered buying branches of the Army, Navy and Shipping Board. Hundreds of factories have been investigated for Government departments and reports made as to their ability to do various classes of work. A complete industrial inventory is maintained and manufacturers in all lines are constantly brought together and given aid in bidding on Government work. The Council of Defense has consistently attempted to take the attitude of finding the Government capacity for things which they had difficulty in placing, rather than attempting to get the easy money for Milwaukee. Approximately $30,000,000 worth of contracts have come directly or indirectly to Milwaukee firms through the agency of the Department of Manufactures. Every industry is organized under a directing committee and all the important ones have either full time or part time secretaries working with the Council of Defense. It is possible instantly to secure any information or refer any requests to the proper channel.

It was noted some six months ago that the large metal working plants were badly crowded with work, while the smaller groups were only working on part capacity. The Metal Trades Committee (Milwaukee Metal Trades Association) immediately took this matter up and arranged for spreading the overflow to other plants. The closest team play exists between the various industries and sub-groups in industries. Plants adapted to making castings are making these, while the machining is done by other concerns, as in the case of rifle grenades and other war materials. A recent war exhibit held during the Liberty Loan campaign showed that Milwaukee was making several thousand different war articles which citizens did not dream were being produced in their neighborhood.

Public Welfare Task Is Important

The care of the civilian population has been an especial function of the Council of Defense. Milwaukee was one of the few cities which did not suffer from the coal shortage, owing to the fact that the coal dealers were organized under the Milwaukee Fuel Board and combined their buying early in the year so that Milwaukee's supply was assured and on the docks. Thirty fuel depots were opened in fire houses and other locations convenient to the residence districts, and during the month of February over 5,000 families were given emergency fuel in lots of two to five hundred pounds to tide them over the delivery tie-up caused by the intense blizzards. One citizen remarked that he hadn't thought much of the Council of Defense until they had secured for him a load of coal when all other appeals had failed, but that hereafter he was "for it." Incidentally the same frailty appeared in sundry manufacturers who were finally steered into war work.

Large quantities of rough fish have been brought in with the aid of the State Council of Defense, and to date over a half million pounds have been sold on the public markets to the poorer people at prices ranging from five to seven cents per pound. Lines a block long of the wives and children of working men have formed even on the bitterest winter days to get this cheap food. One poor woman reported that she had saved for two weeks in order to buy her five pounds of fish, the first meat food her family had had in that time. This, however, was an exceptional case, since the working people of Milwaukee have been very well cared for during the war.

"Eat War Bread" a Milwaukee Slogan

The food conservation movement was in full sway early in July. Milwaukee had put on the market through the medium of her large baking establishments from ten to twenty thousand loaves per week of a war bread which saved approximately one-third of the wheat. The efficient Domestic Economy Division has conducted hundreds of food demonstrations and in addition has published two editions of a war conservation cook book.

The health and nursing situation has not been at all neglected, and strong committees have operated to reduce infant mortality, to train additional nurses, and to provide for the task of keeping the health standards at the most efficient level.

The department of Public Affairs, which is the Education and Morale Division, has literally organized the Milwaukee district down to the last household. Each ward of the City of Milwaukee, and each of the villages and towns surrounding, has its district council of defense with their precinct chairmen and their block captains.

This organization has been particularly useful in putting over conservation movements, aiding in recruiting industrial and military personnel, and especially in handling the financial drives. Not only do the groups of manufacturers, merchants and financial interests carefully canvass their people, but a complete house-to-house canvass of the county is instituted which gives all people not intimately connected with business an opportunity and an obligation to subscribe. Seven big financial drives which Milwaukee has undertaken during the past year have been met with a net oversubscription of 38.88 per cent.

The Department of Commerce and Finance acts as a steering committee for the activities of the big commercial interests in the district, practically all of which are organized. Commercial economies along the line of fewer deliveries, rapid release of cars, the curtailment of unnecessary construction and planning for the substitution of women for male labor have been very carefully studied, and are many of them in effect.

The women of Milwaukee have organized in a remarkable manner for every sort of activity. Over 20,000 workers are aiding in the production of Red Cross articles, while thousands of others are enrolled for food conservation and a host of other activities. The Women's Advisory Committee of the Council of Defense represents all of the important women's organizations and in addition has a complete network of women's councils covering each district. For instance, when a demand was made for clothing for Belgian Relief, a request for 8 tons was met immediately by a collection of 18 tons.

The program of the Milwaukee Council continues on to a host of other activities. Americanization in factories, Red Cross activities, the Central War Finance Board, Central Labor and Employment Bureau, the activities of the Wisconsin loyalty legion—in fact all activities designed to aid the industries, commercial interests, labor, general civilian population and military interests of the district are its province, either directly or through coöperating associations.

The Milwaukee plan, we feel, is unique in that it goes far beyond the creation of a few committees to accomplish a very few specific things. It demands first, the complete organization and analysis of the districts; second, the creation of a large number of advisory committees and coöperating bodies; third, a staff of specialists and secretaries; and fourth, utilization of the real ability which is inherent in the American people to organize themselves and pull together.

Milwaukee is demonstrating that a program of planning and management does not entail sacrifices of individual liberty or the discarding of the great fundamental principles of American democracy. The results of the demonstration are already more than worth while.

Negroes a Source of Industrial Labor

The United States Has a Negro Population of 10,000,000 To Help Meet Our Labor Shortage

By Dwight Thompson Farnham

The author has employed many negroes and has made an extensive study of the [illegible] and problems of employing them successfully. [illegible] records he shows charts of negro [illegible] explaining many of the features as due to racial peculiarities. Still other charts show most satisfactory performances on the part of negro laborers, in some cases the premium earned being in excess of 50 per cent. of the day wages. Good foremanship is most essential in handling all classes of colored labor.

Mr. Dwight T. Farnham's *industrial experience covers some thirteen years in a number of plants as laborer, foreman, superintendent and manager. For the past four years he has been engaged in industrial engineering work; two years as supervising engineer for the Emerson Company, and two in private practice.*

AMERICAN industry has given generously of her second million of workers. Every day further calls are made as the training camps are emptied into our transports.

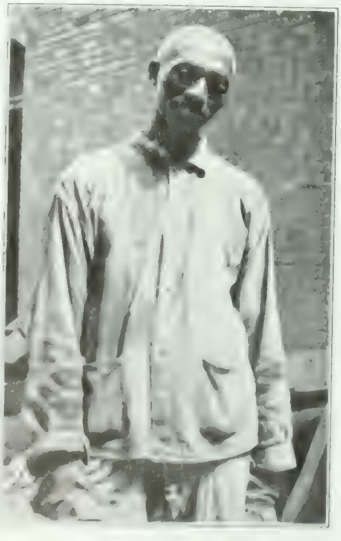
While the Government is doing everything it can to help the manufacturers, carriers and miners of the country by exempting irreplacable workmen and by estalishing Federal employment agencies, it is nevertheless the duty of every manufacturer to act as his own dilution officer and to join with his fellows in the community in performing the duties of allocation officials until such time as the vast Federal machine can become coördinated with his own particular unit of organization.

Last year some of our more progressive corporations awoke to the fact that there was a vast reservoir of labor—amounting to over 10,000,000 souls—nearly 11 per cent. of the country's population — as yet practically untapped for manufacturing purposes. With true American initiative these corporations sent agents into the South. Negro settlements were placarded with notices setting forth the high wages and the ideal living conditions prevailing in the North. Trainloads of negro mammies, pickaninnies and all that miscellaneous and pathetic paraphernalia of mysterious bundles and protesting household pets which accompanies our colored citizen on his pilgrimages moved into St. Louis, Kansas City and Chicago, and from there were distributed to the industrial centers of the country.

The South awoke and chased the corporation agents out of town. Southern newspapers began to tell the negro how well off he was at home and who his best friends were. The North began to discuss segregation ordinances. Some communities took the law into their own hands with results which will be a shame and a disgrace upon their names so long as they exist. Corporations shipped carloads of negro workmen into mining and manufacturing villages, tried them out and shipped them out as utterly useless. Last Fall every train south was filled with darkies whose motto, as one expressed it to me, was, "Back to Alabam' or bust." What was the remedy?

THIS MAN [illegible]

He likes [illegible]



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OUR NEGRO POPULATION

The 1910 census shows about 10,000,000 negroes resident in the United States, located principally in the Southern States, two of which—South Carolina and Mississippi—are more than half populated by them. The distribution in proportion to the total population in the balance of the country is as follows:

Per Cent	
37½ to 50	in Louisiana, Florida, Alabama and Georgia
25 to 37	in Arkansas, North Carolina and Virginia
12 to 25	in Texas, Tennessee, Maryland and Delaware
5 to 12	in Oklahoma, West Virginia and Kentucky
1 to 5	in New York, Pennsylvania, Massachusetts, Ohio, Indiana, Illinois, Missouri, Kansas, Colorado, Wyoming, Arizona, Rhode Island, Connecticut and New Jersey. All other states contain less than one per cent. negroes.

Of the 90 per cent. who are resident in the South about 80 per cent. live in the rural districts, while of the 10 per cent. in the North about 75 per cent. live in the "negro ghettos" in the large cities. Since 1890 illiteracy among negroes has decreased from 57 to 30 per cent. as against a decrease from 6 to 3 per cent. among native whites and from 13.5 to 12.7 per cent. among foreign born. This is a creditable showing when we realize that 90 per cent. of the negroes were illiterate in 1860. Negro prisoners per hundred thousand of population have increased from 325 to 378 in the same period, while white prisoners have decreased from 104 to 89. The percentage of crime among negroes is, nevertheless, less than that of some half dozen immigrant white races which have been coming to America.

A report issued by the Bureau of Education in 1917 analyzes some 5,000,000 negro bread winners—3,000,000 men and 2,000,000 women. Of the former 55 per cent. work on farms, and of the latter 52 per cent. About 12 per cent. of the men are reported under strictly industrial pursuits such as factory workers, railroad laborers and miners, and eight per cent. under the building trades. Incidentally some 30,000 carpenters, 10,000 blacksmiths, 5,000 stationary engineers, 5,000 chauffeurs and 5,000 locomotive firemen are numerated, which bespeaks a certain amount at least of mechanical ability.

The statistical phase of the question is not complete without a word in regard to the foreign born upon whom American industry has leaned very heavily during the past 15 years whenever the rougher sorts of work were to be done. In 1910 we had:

1,343,000	Italians
1,602,000	Russians
1,174,000	Austrians
495,000	Hungarians
4,614,000	Total

SUPPLY OF NEGRO LABOR

We have then a supply of some 7,000,000 to 8,000,000 negro workers—nearly twice as great as the number of foreign born who have done America's unskilled and semi-skilled work in the past and who now are becoming scarce. If the negro can be properly allocated—placed where his weight will be felt most quickly and most directly, as pressure upon the production of those materials most essential to the winning of the war, and if he can be smoothly coördinated with the industrial forces not required for service abroad—in such a way as to supplement, without suggestion of competition and without friction, he will go far to solve the problem of the scarcity of labor which is now our great handicap.

The really serious problem which confronts the would-be user of negro labor is that of handling his negroes in such a way as to avoid disastrous loss of operating efficiency. In the South you will hear two contradictory descriptions, "lazy as a nigger" and "slave like a nigger." Both are right and may apply to the same man. The difference is all in the management. I have had foremen who had been accustomed to the supervision of Americans, Slavs and Italians for years come to me in despair—"I can't do anything with the brutes; if I'm good to 'em they shoot craps and sleep, and if I cuss 'em out they shrug their shoulders and say, 'If you doan' like de way a' wukhs, boss, you can jes' give me mah time!'" The mistake most foremen make is that they use the same method with the negro that they use with white labor. To understand why these are unsuccessful we must understand something of the negro's racial environment and history.

NEGRO LABOR REQUIRES CONSTRUCTIVE SUPERVISION

THE NEGRO'S HISTORY

The transportation of negroes from Africa to the United States began early in the seventeenth century and continued until shortly before the Civil War. Nearly all of them were brought over in slave ships under unspeakable conditions from the Sudan West Coast. A condensed description of the country in which the race lived for centuries throws a light upon certain characteristics which must be understood in order to deal with negro labor successfully.

A CONTINUAL FOLLOW-UP IS OFTEN NECESSARY

The Sudan West Coast, which lies under the equator, extends along about 4,000 miles of coast from Senegambia to Angola and a few hundred miles into the interior to the great African plateau. Hundreds of streams furnish attractive sites for native settlement with easy access to water and food, and a means of rude transportation. Not only is fish in abundance, but wild animals prized for food—the antelope, buffalo, hare, monkey and the elephant, the hippopotamus, alligator and gorilla—are found along these water courses.

The soil is fertile and is luxuriant with edible fruits and nuts. The oil palm, the palm-wine palm, the cocoa and cocoanut palms, the plantain banana, the pineapple and pomegranate, furnish food fit for kings without money and without price—almost without effort.

The West Coast lies wholly within the torrid zone and the humid heat is depressing and exhausting. A tropical temperature prevails continuously and the humidity is excessive for about nine months of the year. The other three months are equally debilitating on account of the parching winds blowing from inland. There are two wet seasons a year, introduced by a number of terrific tornadoes which appear suddenly and with little warning and tear their way through the jungle, leaving death and destruction behind them.

Venomous snakes and mosquitoes infest the land. The tsetse fly infects thousands with the sleeping sickness yearly and makes it impracticable to keep cattle, sheep or horses. The driver ant attacks the villages and forces the natives—rats, snakes, centipedes, bugs, spiders and cockroaches included—to beat a hasty retreat.

Malignant fevers, bred in the swamps and the absence of sanitary or quarantine regulations cause an annual death rate among the natives so great that only their marvelous fecundity has saved them from utter extinction.

The West Africans have no letters, art or science. Their industries are confined to a very elementary agriculture, fishing, a little hunting and some simple handicrafts. Cannibalism which formerly prevailed is now dying out under European influence. Human sacrifice and execution for witchcraft are still practically universal except in regions under the immediate control of white officials. Natural phenomena are explained by reference to spirits and most of the immaturities common among uncultured savages, analogous to childish thought and emotion, are present.

We accuse the negro of laziness. His ancestors picked their food from a bush, fished it out of a stream, or speared it in the next block. Why should he inherit a feverish desire to work? We accuse him of leading a hand to mouth existence. Why should he be obsessed with a desire to emulate the squirrel, when any fruit his ancestors stored would have spoiled and any alligator hams cured would have been carried off by the driver ants? Why should he build him a house for tornadoes and floods to destroy or raise cattle for the tsetse fly to put to sleep? Besides, he didn't feel like it, being wearied by heat and parching winds—and he probably had malaria with like enough a touch of sleeping sickness. Under such conditions you could hardly expect him to be fussy about his clothes or to do much reading evenings. In fact, it is not surprising that he was a bit uncultured at times, given to dining on his enemies and indulging in super-Wagnerian music and voodooism.

The Negro is Different

Once the plant executives, the foremen who come in contact with the workmen, realize that the negro is different physically, temperamentally and psychologically from any of the white races, the battle is half won. At first the tendency is to regard him either with intense hatred or else as a joke—a remnant of some minstrel show, organized especially to furnish innocent merriment. The man who hates the negro very seldom ever gets on with him. The darky is as quick to feel dislike as a child and resents it accordingly. The man who regards his antics at first with amused toleration is much more likely to eventually control him, although there will be a great many periods of discouragement when the amateur overseer will feel very much as did A. B. Frost's dominie who rescued the bull calf and undertook to lead him to safety with the halter tied about his waist. Sympathy and understanding are necessary but sentimentality is fatal, as experience demonstrates.

Misunderstandings Are Easy

The negro's responsiveness very often leads to serious misunderstandings. He will generally listen respectfully and appreciatively to what you say and seem to understand exactly, when, as a matter of fact, he has not the faintest idea what you are driving at. If you have been used to driving your meaning home to some foreign-born citizen with exhausting gestures and extravagant facial gyrations your first feeling is one of relief at having an honest-to-goodness American to deal with. But when your colored auditor goes and does exactly what you told him not to do, or quits on pay day after accusing you of gross misrepresentation and unfairness, you begin to long for your erstwhile audience of Southern Europeans who had to have the word hammered into them with a club but who understood it once the operation was completed. The remedy is, of course, extreme care and conscientiousness in explaining to the negro exactly what you want him to do and also exactly what you do not want him to do. Then make him tell you in his own words what you said to him and stay and see that he does it that way.

In matters of wage agreements it is particularly essential to avoid misunderstanding, as long and bitter experience has made the negro suspicious of the white man in financial matters. This is particularly true of the Southern negro who has worked in some turpentine camp in which as one owner expressed it, "We keep our labor turnover down by seeing to it that the niggers always owe money to the company store. We are 40 miles from the next town, and if they don't have railroad fare they stay." When a negro does not understand what you told him and does not find as much money in his pay envelope as he expected he consequently suspects the worst and acts accordingly.

Irish Make Good Negro Bosses

There seems to be something about the regular Irish "boss" which is exactly what the negro needs. A lieutenant commander in the Navy—an engineer officer whose ships had held the efficiency pennant time and again—told me that an engine room full of negroes under an Irish boss would do quite as good work as a room full of German square-heads. A large steel mill, which about five years ago had the choice of several sorts of labor, deliberately chose negroes and ever since has worked them most successfully under Irish bosses. I have watched the thing myself and there seems to be something about the Irish, cheeriness coupled with an occasional terrifying outburst of authority, which "tickles the negro most to death" and which keeps him good naturedly working with a weather eye out for storms. The type of Scot or New Englander who has no patience with any except those thrifty souls who work unwatched from a strong sense of duty, has no business trying to handle the negroes. Tolerance, sympathy and an understanding of human weaknesses which can exist without utter damnation of the individual who possesses them, are as necessary with the negro as with the child. If you are given to austerity and enraged by ingeniousness, hire somebody else to boss the negroes who work for you if you wish to avoid trouble.

Firmness Needed With the Negro

As in dealing with the child, firmness is absolutely necessary. If you tell a negro to do anything, see that he does it—or that he departs elsewhere immediately. But be sure he understands you before you lose your temper at what seems to be sulkiness or disobedience. When I was in the third grade at school a youngster I knew was punished repeatedly for disobedience and for impudence. It later developed that he was nearly deaf. It is necessary to remember in handling the negro that his responsiveness when addressed and his apparent willingness to please may be assumed to cover a slow understanding which it is not fair to blame him for. He is not above trying you out, however, just as the class of youngsters tries out a new teacher, nor is he any more scrupulous of taking advantage of you, if you prove to be "easy," than is the average young devil who attends our schools.

Negro Absenteeism

A Southerner told me last winter that as soon as the negro earned more than $1.50 a day he began to take time off to spend it. While the percentage of absentees among negroes is about twice that of Americans and 40 per cent. greater than among Italians, it has been my experience that sweeping generalizations among negroes are quite as unsafe as among any other class of citizens. There are some of them who work just as steadily, just as hard and just as loyally as any white man. There are some who are as shiftless as the most shiftless white man and more cannot be said. Whether your negroes are prone to absenteeism depends upon what sort of negroes you select and upon how you treat them. An employment manager in one of the largest cities in the country recently told me that he could tell what sort of a man he was getting as soon as he found out what "ghetto" he lived in. As a usual thing the Southern negro is a better worker than one who has been too long a resident of a northern city where he has been subject to the evil influences and to the vices which exist in our larger commercial centers.

Labor turnover among the unskilled is about 50 per cent. greater among negroes than among the whites. This can be reduced by selecting your negroes, but certain other considerations are very important. The negro is fond of family life and is much more likely to remain if he can rent a house near the plant and move in his women folks and the various pets which seem necessary to his existence. He prefers to live near the plant because he enjoys a family party at the noon hour and, where circumstances permit, he appreciates an opportunity to acquire the various back-door perquisites such as kindling wood and the like which residence close to the factory makes convenient.

Another foible of his is the desire for frequent pay. One public utility company in a middle western city took advantage of this last summer and secured sufficient men to do considerable grading at $1.75 per day as against current rates of $2.25 per day, by paying off every evening. I would not advise any such procedure on manufacturing work, however, as the men so secured are of the most shiftless and transitory class and cannot be depended upon to remain, even while they are learning their job.

Someone Must Think for the Negro

From an economic standpoint the man who can think for the greatest number of other men is the most valuable. He grades all the way down from a Lincoln or a Wilson, capable of thinking for a nation, to the working leader of a two man crew. The less thinking a man can do for himself the larger proportion of what he earns has to go to someone else for supervision. The rank and file of negroes require more supervision than the rank and file of whites. By this I do not mean more "driving" nor more "watching," I mean constructive supervision in the sense of thinking for and looking ahead for. We must provide the negro with the foresight of which his ancestor's environment has largely deprived him.

To illustrate what I mean take his method of performing a simple operation like loading a box car. A crew of negroes, given a contract on a job of this sort, which they have performed perhaps only two or three times before, will stand and regard it dubiously for several minutes and then one of them will depart for a plank. The rest stand and wait until he returns and then per-

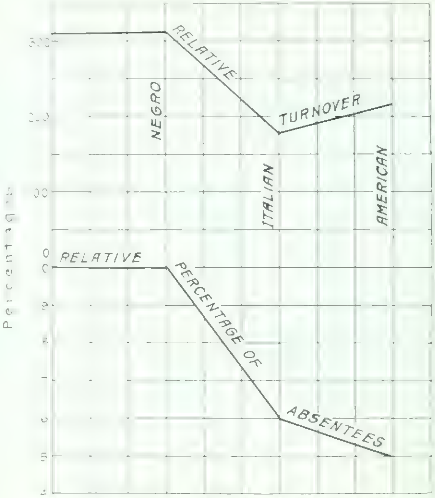


CHART 1. COMPARISON OF LABOR TURNOVER BY RACES

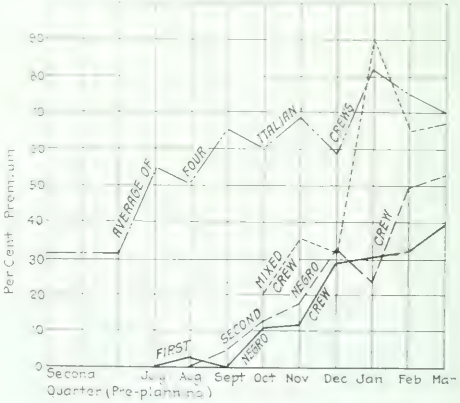


CHART 2. COMPARISON OF NEGRO, ITALIAN AND MIXED CREWS ON SAME WORK

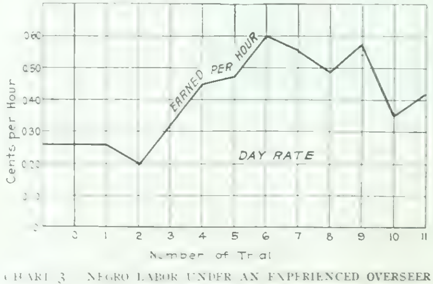


CHART 3. NEGRO LABOR UNDER AN EXPERIENCED OVERSEER

haps after some hesitation one will help him place one end of the plank in the car door. It then occurs to another that a brace under the plank must be provided. Thereupon he departs and eventually returns with a box. This is inserted under the center of the plank. The rest of the crew then depart in search of wheelbarrows, which they proceed to load. The first one who tries to wheel up the plank finds that it cannot be done without something to help the barrow over the bump where the plank rests on the ground. Considerable discussion thereupon ensues and a third darky departs for a piece of sheet iron while the rest sit on their barrows until he returns and places it over the lower end of the plank. The time consumed getting started amounts to about 30 minutes for each of six men.

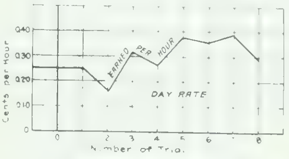


CHART 4. RESULTS OBTAINED BY THE SECOND FOREMAN WITH NEGROES ON PIECE RATES

A crew of Italians given the same contract would jabber excitedly for a moment, then one would depart for the plank, another would for the box, and a third for the sheet iron, while the rest of the crew went for wheelbarrows for all. At the end of five minutes all would be wheeling goods into the car and earning money. Under the circumstances, if you handle your colored help in the same manner as you do your white laborers you will quite naturally have trouble getting them to enthus over piece rates.

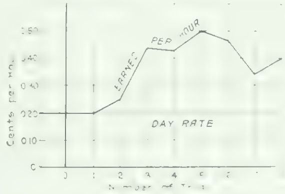


CHART 5. WHAT THE THIRD FOREMAN ACCOMPLISHED

This example is in no way an exaggeration. Only a few days ago a negro handling material into a conveyor, complained to me that his shin was getting sore because he was continually hitting it on the conveyor support. His coat hung near by and I suggested he hang it over the projection and so protect himself. He did so and was as pleased as he could be. All he needed was someone to do a little thinking for him. If I had not happened along he would quite likely have quit his job.

SPEED OF THE LAZY MEMBER

Another difficulty with getting negroes onto task work is due to a temperamental peculiarity which leads the whole crew to slow down to the speed of a lazy member, rather than to urge him to greater exertion. This invariably happens unless it is provided against and the slacker removed. Americans, Italians or Slavs will drive a slacker either to work or to get off the job, but the negro is inclined to accept such an occurrence as a visitation of fate to be borne rather than to be struggled against. As a result the whole crew slows down and unless the day rate is guaranteed the crew leaves the works in a body.

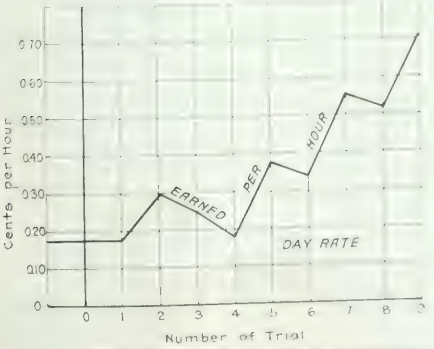


CHART 6. RESULTS OBTAINED BY THE FOURTH FOREMAN

Under some circumstances it is necessary to furnish will power as well as foresight. Time and again I have argued with a crew which would listen and debate and regard with clouded brow until despairing of getting them back to work by persuasion, I would order them back to work, whereupon they would all go back on the job without another word and in a few minutes everything would be forgotten and they would work contentedly for the rest of the day.

MUST BE CONTINUALLY FOLLOWED UP

What seems to be needed is a continual follow-up, by someone who can inspire respect. One foreman whom I knew—an old steamboat captain who had handled negroes on the Mississippi all his life—seemed to know instinctively when each man under him needed attention. He would move from one end of the warehouse to the other with a word of encouragement here, an order there and with surprisingly few reprimands would keep every man at work all the time. When he came to the job he brought about eight men with him and he had a labor turnover of about 12 per cent. a month, while other foremen who fairly coddled their men were running considerably over 100 per cent.

It is very seldom that a crew of negroes will work under a negro boss. They prefer to be bossed by a white American. I have known several instances where southern Europeans have worked without friction under a negro, but I can recall no instance where negroes have been put under a southern European boss without continual charges of discrimination on the part of the negro. I do not know why this is so, unless it is that personal loyalty is often a strong motive in governing the negro's actions and that his idea of a boss is cast in a single mold.

It is necessary, then, to supply the usual negro laborer with someone to think ahead for him and when necessary with some one to make up his mind for him. If his boss in addition understands him, makes allowance for his inherited "differences," treats him fairly, jollies him occasionally without indulging in undue familiarity and give him to understand at all times that orders are to be obeyed strictly and to the letter such intensive and constructive supervision will produce a quantity and quality of work which will surprise the man who has tried only the casual type of supervision with which he has managed to control central Europeans or Americans.

CAPACITY FOR INDUSTRIAL WORK

How far up in an industry the negro can be used depends entirely upon the sort of negroes you secure. Mathews was captain of the Andover baseball team and in every way was such a success that more than one scion of an old southern family was glad to play under his leadership. I have known negroes who possessed unusual mechanical ability in addition to executive ability. While such men are comparatively rare, it is, nevertheless, possible to use negroes very successfully on most sorts of semi-skilled work, if you use care in their selection. A very good plan at first is to survey the industry and list the more simple jobs upon which it is certain the average negro can be used with a fair chance of success. It is time enough to try them on the more complicated operations, once they have demonstrated their ability to perform the less intricate tasks. Negroes seem especially well suited to furnace tending and the more simple heat-treating operations. There is something about periodic work which suits him and he will work desperately provided he knows the rest period is certain. He minds heat less than cold and will work in the sun under conditions which would result seriously if attempted by a white man.

Whenever negroes are expected to work outdoors in wet weather or in cold weather it is necessary to exert a certain amount of paternalism and to insist on proper clothing. The negro does hate to spend money for shoe leather and either starts for home, or lays off the next day with a cold, if he is not forced to protect himself. If absenteeism occasioned by sickness is to be avoided supervision must be extended sufficiently to insure his taking reasonably good care of himself. He is inclined to wrap up wounds in old rags and will often risk blood poisoning rather than undergo the pain of having a hurt dressed. On the other hand he seems to take to bathing naturally. I have had to fairly drive them away from their bath house when certain foreign born laborers in the same plant could hardly be induced to use their showers; surely an interesting comparison.

Some Segregation Necessary

A certain amount of segregation is necesssary at times to preserve the peace. This is especially true when negroes are first introduced into a plant. It is a question if it is not always best to have separate wash rooms and the like. In places where different races necessarily come into close contact and in places where inherited characteristics are especially accentuated, it is better to keep their respective folk-ways from clashing wherever possible. Separate work rooms or even division into crews on strict racial lines are not at all necessary, if both races are given to understand that each will be fairly treated, but that swift justice will be meted out to the man who starts something.

Results in the Negro Labor

Chart 2 shows the premium earned by two colored crews on semi-skilled work as compared with the average premium earned by four Southern European crews and by a mixed crew. It will be noted that the first half of the year the negro crews earned no premium. In fact they not only earned no premium during the second quarter of the year, but they took so long to perform their task that the departmental production was seriously menaced at times. Their first premium earnings in July were very small and incidentally very spasmodic and discouraging both to the men and to the foremen who were trying to beg and belabor them into premium earning speed. In October constructive supervision began and from then on the improvement in earnings is much more encouraging. There were occasional set-backs due more than anything else to negro leaders becoming slack and having to be replaced, but the progress is, on the whole, steady. The work of the mixed crew is surprising. It began to earn premium almost at the start and while given to violent fluctuation at times, finally closely approximated the earnings of the Southern Europeans. The chart is of further interest in that it shows how the introduction of scientific planning during the second quarter of the year increased the average premium earned from 31 to nearly 70 per cent. in excess of the day rate simply by making it possible for the crews to "let themselves out."

Chart 3 shows the results obtained by an experienced overseer of negro labor during his first attempts to get his crews on the piece rates. It will be noted that the first trial resulted in day rate being earned. The second trial was a failure. At the third trial they really got their teeth in and from then on earned almost double the amount secured on the first attempts.

Chart 4 shows the first attempts made by a foreman of unusual intelligence and initiative but inexperienced with negro labor. The premium earned was less but perseverance and resource resulted in the crews earning enough to keep them contented and to prevent the company losing them.

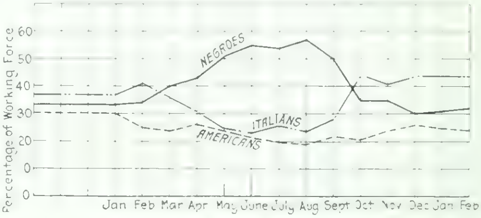


CHART 7. EXAMPLE OF DELIBERATE SEASONAL RACIAL REPLACEMENT

Chart 5 shows the results obtained by a third foreman who did not propose to be left behind in the race for getting the negroes to respond to piece rates. He studied the methods of the experienced overseer and applied them very successfully.

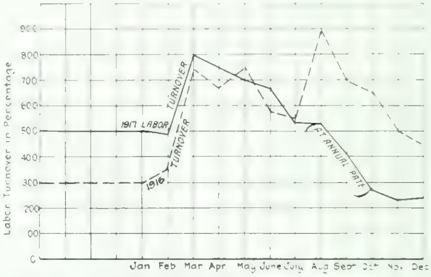


CHART 8. EFFECT OF DELIBERATE SEASONAL REPLACEMENT

Chart 6 shows what an Irish boss could do when he set his mind to it. It is apparent that he made his mistakes, but he kept everlastingly at it and jollied and bluffed his crews into doing very well for themselves.

Charts 7 and 8 show what may be done by means of deliberate seasonal replacement. The racial tendencies of different classes of labor have so far been insufficiently studied in America. It may be that the direction of the Federal Government will be attracted to this very important matter sufficiently during the coming year by the statistics gathered by the various National employment agencies to make it possible to determine the laws under which this racial flow operates and to meet in some way a phenomenon which at present causes considerable economic loss, not only to the manufacturer who loses his men, but to the workman who moves himself and his family several times, seemingly unnecessarily, during the year. It may be that education for the workman will solve the problem, but I am inclined to think that the employers are quite as much to blame in the way they plan and finance their work. Misrepresentation of wages and living conditions also play a part in this stimulation of movement and unrest and the manufacturer and the employee both suffer. The sooner manufacturers stop trying to coax men away from each other and adopt some plan of coöperation, the sooner will one of our greatest economic wastes be stopped.

In the spring the negro is willing to move north. In the autumn he goes south for the cotton picking, which begins in October. He does not like the northern winter and even if he sticks it out through November he generally cannot stand the idea of missing the Southern Christmas.

As the Italian takes the road in the Spring the negro can be induced to fill his place, and when in the Autumn the negro goes south for the cotton picking and Christmas possum the Italian can be encouraged to "dig in" for the winter.

Chart 7 shows the deliberate replacement in one plant of Italians by negroes in the Spring, and the replacement of negroes by Italians again in the Fall. It will be noted that the Americans on the most skilled operations remained close to 25 per cent. of the working force while the negroes increased from 33 per cent. in January to 57 per cent. in August and decreased to 35 per cent. in October and to 30 per cent. in December. The curve which represents the Italians began the year at about 40 per cent., fell off to 25 per cent. in the summer and rose again to 45 per cent. in the Autumn. It will be noted that throughout the seasonal fluctuations a nucleus of each race amounting to at least 20 per cent. of the working force was retained.

The result of the adoption of this deliberate policy of seasonal racial replacement is shown by Chart 8. In fact it may be more acurate to state that the 1916 turnover curve was one of the most moving reasons for the adoption of the replacement policy. It will be observed that the 1916 turnover, figured each month in terms of annual turnover, began the year at about 300 per cent. As soon as railroad work opened in March it jumped to over 700 per cent. where it remained until the most necessary reconstruction work was accomplished, dropping down to about 500 per cent .in June and July. In August construction work was rushed in order to get ready for the winter and the turnover went up to 900 per cent. By December the turnover was shown about to normal.

Conditions at the beginning of 1917 were even worse than they had been the year before on account of the greater general labor shortage throughout the country. January began with 500 per cent. March reached 800 per cent. It was, therefore, decided to endeavor to avoid the conditions of the previous year by using negroes to fill the gaps in the working force. The balance of the curve tells the story. By August the turnover had dropped to 530 per cent. as compared with 900 per cent. the year before. By September it was down to 400 per cent. and in October it was below that of any month for two years. The Italians came back in the Fall. The Negroes went south. One replaced the other almost without friction and the plant's output increased steadily.

What can be done in one plant can be done in another. The most difficult task is that of training the foremen to meet the new conditions. Patience on the part of the management combined with the willingness to spend a little more for the necessary intensive supervsion and possibly for foremen experienced in overseeing negro labor will generally show even the most hide-bound and recalcitrant foreman that the negro can perform successfully a surprisingly large proportion of our various industrial operations.

Time Studies for Rate Setting on Gisholt Boring Mills--II

By Dwight V. Merrick

In this article Mr. Merrick *presents tables for the operations of hoisting and landing work, squaring and levelling work and making it run true, and clamping and holding work. These complete the fundamental operations down to the setting of the cutting tools which will be taken up in next month's installment.*

Mr. Dwight V. Merrick *served a three years' machinist apprenticeship in the shop of the Southwark Foundry & Machine Company, going from there as a journeyman machinist to William Sellers & Company, where he remained for one year. He then spent three years in the engineering course at Drexel Institute. After this he went back to the Southwark Foundry & Machine Co. for three years, leaving in 1898 to go with* Mr. Frederick W. Taylor *at the Bethlehem Steel Company. In 1901 he left Bethlehem to go to the Link Belt Engineering Company, where he remained until 1911, devoting himself to time-study work. The following two years, 1911-1913, were spent in time study in the shops of the Watertown Arsenal. From 1913 to date* Mr. Merrick *has devoted himself to a consulting practice in time study, giving most of his efforts to the H. H. Franklin Manufacturing Company and in the manufacture of rifles, rifle ammunition and machine guns.*

UNDER the general headings of landing work in the machine and removing work from the machine are given all of the tables bearing on the operations necessary in lifting, transporting, lowering and landing a piece of work in a machine, or on a machine plate or table, and then the operations in reverse order necessary to remove the work from the machine. Some of these operations are done by hand, others by hoist or other lifting or transporting devices. Landing and removing naturally are grouped together for the reason that the one is the reverse of the other.

In general the landing and removing operations may be divided into two classes, namely, work that is handled by hand and work that is handled by a hoist. For work falling in the latter class a sling of some kind must be secured to the piece before it can be hoisted. For the reason that securing a sling to a piece of work is so closely connected with the operations of landing and removing when using a hoist, tables covering the use of a sling are given under the same general head.

The line of division between work that can be handled by hand and work that must be handled by hoist is dependent upon the weight or bulkiness of a piece and can be taken at about 100 pounds. However, this weight varies somewhat under different conditions, being dependent upon the height to which the work must be lifted and the general surroundings of the machine. Of course, the ruling factor is the physical strength of the workman. It is desirable, so far as possible, to favor the operator, and for that reason a weight of 80 pounds is a better one to take on the general run of machine-shop work. The heaviest test piece used in taking the time study observations upon which the tables on this article are based was 107 pounds.

There are a great many ways in which a piece of work can be slung in order to hoist it with ease and safety, furthermore there are many different kinds of slings. Among the most commonly used machine-shop slings is the endless rope or endless chain, and a large steel ring with two, three or four chains linked to it, each chain having at its free end a lifting hook. In shops where the equipment is well cared for, the different types of slings are standardized and periodically inspected.

Tables 16 and 17 apply to method of slinging a cylindrical piece with a hole in the center using a 1-inch rope sling about 15 feet long and a wooden bar 2 x 4 x 43 inches in size. Table 16 is for securing the sling preparatory for hoisting and Table 17 gives the detailed time for the operation of securing the rope to the hoist and removing the piece. The methods of securing is to loop the ends of the sling and place them over the ends of the bar as shown in the sketch accompanying the tables. The bar is slipped into the hole at the top and the bight of the sling is hooked on to the crane. The sling is made taut bringing the bar to the edges of the hole. This permits the piece to be lifted from the floor in a horizontal position.

TABLE 16

DETAIL TIME OF OPERATION TO LAND PIECE FROM FLOOR TO MACHINE BY HAND

Operation: Land piece on machine, by hand.
Tools required: None.

Details of Operation	WEIGHT IN POUNDS										
	5	10	20	30	40	50	60	70	80	90	100
1. Pick up piece six feet away and land in machine by hand. .	0.10	0.11	0.127	0.148	0.173	0.20	0.23	0.26	0.29	0.32	0.35

TABLE 17

DETAIL TIME OF OPERATION TO REMOVE PIECE FROM MACHINE TO FLOOR BY HAND

Operation: Remove piece from machine to floor by hand.
Tools required: None.

Details of Operations	WEIGHT IN POUNDS										
	5	10	20	30	40	50	60	70	80	90	100
1. Pick up piece from machine remove to floor six feet away	0.077	0.085	0.098	0.114	0.132	0.152	0.174	0.195	0.213	0.23	0.246

Note: In landing a piece on the table and removing it by hand, a man walks to the piece six feet from machine, lifts 3½ feet, returns six feet and lands it in the chuck jaws.

The tables show the time required to loop the rope over the bar, and place the bar in position under the piece to be lifted, and also the time required for making the sling taut after hooking on the crane.

Another method is to use the same sling looping one end around the piece itself, passing the bight over the crane hook and looping the free end around the opposite side of the piece. The end of the sling is then passed between the two ropes forming one leg of the bight and the bar passed through the loop in the end, after which the sling is made taut. The latter method is applicable only to light work.

In all work that is to be handled by a crane the next piece which is to be placed in the machine should be handled before the crane is permitted to depart. If, on account of the conditions in the shop long waits are necessary before the crane is available, the time allowed for waiting for the crane should be added as an item in the time allowed for removing the piece from the machine whether the man takes advantage of this allowance each time he removes the piece from the machine or not.

For landing or removing work, whether by hand or hoist, distinction is made in the tables according to the weight of the piece. Times for a piece as light as 90 pounds are shown for handling by hoist, and times for a piece as heavy as 100 pounds are given for handling by hand. On small machines most operators can handle pieces of 100 pounds by hand without over exertion. Where a great many pieces are to be worked upon it is probably advisable to count on handling by hand, for few operators will bother with a crane and the waits connected with it, but in ordinary cases 80 pounds in weight is about the maximum for handling by hand. In the tables in this article it is assumed that where a piece is handled by hand, the man walks about 6 feet from the machine, picks up the piece, returns to the machine, lifts it a distance of 3½ feet and lands it in the chuck jaws.

In handling a piece by the crane, the piece is first slung by one of the approved methods and is then hoisted about 4 feet before being transferred to the machine. The table assumes a movement of 15 feet from the pile of pieces to the chuck jaws. In all cases of slinging, the sling must be removed when the piece has been landed at its destination. It is evident that a determination of the time required for slinging is dependent upon whether the piece is removed from the floor or pile or from the ma-

TABLE 18

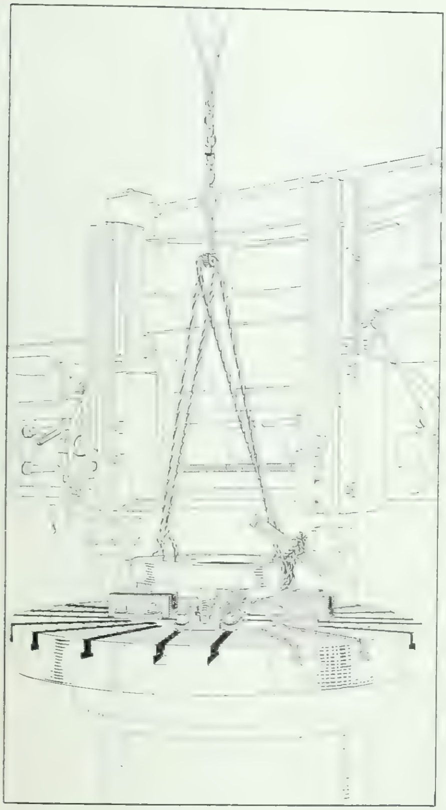
LAND AND REMOVE WORK BY HOIST; DETAIL TIME OF OPERATION TO SECURE ROPE ON PIECE TO HOIST AND LAND ON MACHINE

Operation: Securing a piece of work, preparatory to hoisting.
Tools required: One-inch rope sling about 15 inches long; wooden bar, 2 x 4 x 43 inches.

Details of Operation	Weight in Pounds		
	To 150	Above 500	About 1000
	Time in Minutes		
1. Crane moved over work.	0.20	0.20	0.20
2. Loop rope on bar, bar into work and rope on crane hook.	0.56	0.76	0.88
3. Make rope taut.	0.08	0.11	0.13
Total, securing rope to hoist	**0.84**	**1.07**	**1.21**
4. Hoist and land. . . . . .See Table 20			
5. Remove rope.	0.19	0.23	0.26
Total, removing rope after piece has been landed	**0.19**	**0.23**	**0.26**

chine. The time required for slinging a piece which is on the machine is greater than the time for slinging a piece landed on the floor or on a pile.

It is wise to point out that the tables given here for landing and removing are limited. It is not my object to cover this entire field, for the conditions of landing and removing vary with every shop, and even if they have been standardized for a particular class of work, they would still differ under different situations.



The tables covering landing and removing work are from 16 to 20, inclusive.

MAKING PIECES RUN TRUE

In making pieces run true on a table of a vertical boring mill rough pieces that do not require accurate setting may be required to set on the chuck jaw of the table and be trued only with reference to the circumference of the machine table. In general the operation may be divided into two classes: 1. For single pieces; 2. For duplicate pieces.

For duplicate pieces the operation described for single pieces must be performed for the first piece of the lot and, sometimes, for the first two pieces. After that the same chuck jaw or jaws should be opened each time for the removal of the piece, and those that are to be opened should be prominently marked. If this is done truing the piece of work becomes unnecessary, it is simply placing a piece in the chuck jaws and tightening the jaws that were previously opened.

TABLE 19

DETAIL TIME OF OPERATION TO SECURE ROPE ON PIECE TO HOIST AND REMOVE FROM MACHINE

Details of Operation	Weight in pounds		
	To 150	Above 500	Above 1000
	Time in Minutes		
1. Call crane.........	1.50	1.50	1.50
2. Crane moved over work............	0.20	0.20	0.20
3. Loop rope on bar, bar into work and rope on crane hook	0.43	0.62	0.74
4. Make rope taut................	0.08	0.11	0.13
Total, securing rope to remove...	**2.21**	**2.43**	**2.57**
5. Hoist and remove................................See Table 21			
6. Remove rope	0.17	0.20	0.23
Total, removing rope after piece has been removed	**0.17**	**0.20**	**0.23**

For single pieces the process of truing is as follows: The piece having been landed in the chuck jaws, the workman procures his chuck wrench, tightens the jaws upon the piece, and lays down the wrench. He then rapidly travels the head over to the edge of the piece and puts a finger in the tool post to facilitate testing the trueness of the piece. The time in the table for this item is the time required to rapidly travel the head from its normal position at the end of the cross rail to the edge of a piece 66 per cent. of the diameter of the table. (This approximation can be used for the ordinary run of work. If, however, a piece is being machined that is disproportionate to the size of the machine the time for rapid travel should be taken from the tables relating to that particular operation.) The test finger being in

TABLE 20

DETAIL TIME OF OPERATION TO HOIST PIECE FROM FLOOR AND LAND IN MACHINE

Operation: Hoist and land piece on machine.
Tools required: 10-ton Shaw electric traveling crane.

Detail of Operations	WEIGHT IN POUNDS											
	90	100	125	150	200	250	300	400	500	700	1000	1250
1. Secure rope to hoist (Table 16)...........	0.84	0.84	0.84	0.84	1.07	1.07	1.07	1.07	1.07	1.21	1.21	1.21
2. Hoist (about four feet)	0.10	0.10	0.10	0.10	0.102	0.103	0.104	0.107	0.11	0.117	0.135	0.155
3. Travel to machine table (fifteen feet)........	0.15	0.15	0.15	0.151	0.155	0.16	0.165	0.175	0.185	0.205	0.238	0.270
4. Lower and land piece in jaws	0.11	0.110	0.11	0.113	0.117	0.12	0.123	0.13	0.136	0.153	0.175	0.195
5. Removing rope after piece has been landed Table 16	0.19	0.19	0.19	0.19	0.23	0.23	0.23	0.23	0.23	0.260	0.260	0.260
Total time to hoist and land..............	1.39	1.39	1.39	1.394	1.674	1.683	1.692	1.712	1.731	1.945	2.018	2.090
Total for practical use	**1.40**				**1.70**					**2.00**		

place the table is started and the truth of the piece is tested and the table stopped. By adjusting the proper jaws, the piece is brought more nearly concentric with the table and its condition is again examined by starting the table and testing with the test finger. This operation is repeated until the piece runs true. Then all the jaws are tightened, the chuck wrench is removed to the tool stand and the test finger is taken from the tool post. In the table allowance has been made in machines up to 42 inches for three tests with the test finger before the piece is finally made to run true. In the sizes above 42 inches four tests have been allowed. This number of tests should be ample for a skilled workman.

TABLE 21

DETAIL TIME OF OPERATION TO HOIST AND REMOVE PIECE TO FLOOR

Operation: Hoist and remove piece from machine
Tools required: 10-ton Shaw electric traveling crane.

Details of Operations	WEIGHT IN POUNDS											
	90	100	125	150	200	250	300	400	500	700	1000	1250
1. Secure rope to hoist (Table 17)	2.21	2.21	2.21	2.21	2.43	2.43	2.43	2.43	2.43	2.57	2.57	2.57
2. Hoist (about two feet) from chuck jaws ..	0.07	0.07	0.07	0.07	0.071	0.072	0.073	0.074	0.075	0.082	0.096	0.11
3. Travel to pile (about ten feet)	0.116	0.118	0.12	0.122	0.125	0.128	0.132	0.140	0.150	0.165	0.194	0.22
4. Lower and land piece on pile	0.077	0.078	0.079	0.081	0.083	0.086	0.090	0.096	0.105	0.116	0.138	0.16
5. Remove rope after piece has been removed to floor (Table 17)......	0.17	0.17	0.17	0.17	0.20	0.20	0.20	0.20	0.20	0.23	0.23	0.23
Total time to hoist and remove piece to floor	2.643	2.646	2.649	2.653	2.909	2.916	2.925	2.940	2.960	3.163	3.228	3.29
Total for practical use	2.60				2.90					3.20		

Note: In landing piece on table and removing by hoist, the crane hoists the piece about four feet and travels to the table about fifteen feet and lands in the chuck jaws.

TABLE 22

DETAIL TIME OF OPERATION TO MAKE PIECE RUN TRUE IN CHUCK JAWS

Operation: Make piece run true.
Tools required: Chuck jaw wrench.

Details of Operation	Size of machine in inches				
	30	36	42	60	84
Number of jaws tightened on piece after landing[1]	1	1	2	2	2
1. Pick up wrench, tighten jaws on piece and lay wrench down (Table 23)..........	0.44	0.49	0.54	0.80	
2. Rapid travel head (to use head as rest to test trueness	0.43	0.38	0.48	0.40	
3. Put finger in post[2].........	0.22	0.23	0.24	0.27	
4. Start table test for trueness (with chalk) and stop table	0.35	0.39	0.43	0.45	
5. Set piece true by adjusting jaws	0.22	0.25	0.28	0.60	
6. Repeat item 4	0.25	0.28	0.30	0.45	
7. Repeat item 5	0.22	0.25	0.28	0.60	
8. Repeat item 4.......	0.25	0.28	0.30	0.45	
9. Repeat item 5				0.60	..
10. Repeat item 4...				0.45	
11. Tighten all jaws tight and remove wrench to tray (Table 23)	0.31	0.49	0.55	0.72	
12. Remove finger from post	0.11	0.12	0.13	0.16	
13. Rapid travel head over to one side................	0.43	0.38	0.48	0.40	
Total	3.23	3.54	4.01	6.35	

---

[1] Number of jaws indicated are those that are tightened on the piece as soon as it has been arranged in place.

[2] Usually this indicating finger is a very small device consisting of a piece of wood with a nail driven into the end so that when the head of the boring mill is moved over this nail is in such a position that it can be used as an indicator to test the trueness of the piece. It is evident that anything that will present a sharp point to the work will do just as well.

Note: In Table 22 is given the time to true up a casting or smooth forging that does not require very accurate setting. As it sets on the jaws of the chuck no levelling is necessary and it runs with sufficient truth if it is within about 1/64 inch. This table applies to the first piece chucked after the jaws have been set, as shown in preceding tables referring to preparation time. The same time should be followed for succeeding pieces if there are only a few to be done. In case there are a number of pieces to be machined of the same size and kind, and if the castings or forgings are fairly smooth and round it will only then be necessary to land a piece in the jaws and tighten the jaws against it after the first piece has been made to run true. However, when the first piece is taken out the jaw or jaws that are loosened to remove this piece must be marked so that when the next piece is put in it is easily seen which jaws are to be tightened against the piece. Under these conditions no truing of the piece will be necessary. The time required for tightening will be found under the heading of clamping or otherwise holding the work.

TABLE 23

DETAIL TIME OF OPERATION TO TIGHTEN JAWS ON WORK

Operation: Tighten jaw on work, and loosen jaws.
Tools required: Chuck jaw wrench.

Details of Operation	Size of machine in inches				
	30	36	42	60	84
Number of jaws tightened on piece after landing.........	1	1	2	2	2
1. Pick up wrench, tighten jaws on piece and lay wrench down	0.44	0.49	0.59	0.80	
2. Tighten all jaws tight and remove wrench to tray.......	0.31	0.49	0.55	0.72	
Total time for tightening	0.75	0.98	1.14	1.52	

CLAMPING OR OTHERWISE HOLDING THE WORK

There are many ways of holding the work securely on the tables of boring mills, the most common one being the use of three- or four-jawed chucks. Tables 22 and 23 give detailed times for the operation of one type of chuck as illustrated in connection with the tables. In most cases the use of chuck jaws are limited to cylindrical pieces that will allow the jaws to get a grip. In a modern boring mill the chucks are usually of substantial design and are convenient for a wide variety of work. On some of the older types of mills the work must be held by straps, clamps and bolts. The heads of the bolts enter T-slots in the table. Furthermore, besides the clamps it is necessary to set stops to prevent the work from moving.

TABLE 24

DETAIL TIME OF OPERATION TO LOOSENING JAWS TO REMOVE PIECE

Operation: Tighten jaw on work, and loosen jaws
Tools required: Chuck jaw wrench

Details of Operation	Size of machine in inches				
	30	36	42	60	84
Number of jaws loosened	1	1	1	2	
1. Get chuck wrench from tray.	0 035	0.04	0 045	0 06	
2. Loosen jaws to remove piece.	0 12	0.18	0 24	0 50	
3. Remove wrench to tray	0 035	0 04	0 045	0 06	
Total time to loosen jaws	**0.19**	**0.26**	**0.33**	**0.66**	

Note: In machining duplicate pieces the jaw or jaws which are to be opened each time should be marked so that when each piece is put in, these jaws can be readily identified.

In connection with Table 23, if it is necessary to true up the pieces the time for tightening the jaws and making the pieces run true, are given in Table 22. For duplicate pieces, after the first piece is trued up no further truing is required if the castings and forgings are fairly smooth. So it is then only necessary to tighten the jaws: the times as per Table 23.

Even on the modern mills fitted with chucks certain pieces sometimes require straps or clamps and stops in addition to the gripping action of the chuck jaws.

Relation Between Production, Development and Sales

By George J. Kirchgasser

With the Cutler-Hammer Mfg. Co.

EIGHT years ago a manufacturing concern well established in a line in which it had grown up, added a new department for the development and manufacture of electric-heating appliances for the household. This field was already tenanted and keen competition existed.

To compete in price with other manufacturers was out of the question at the start because minimum prices meant big production and, since an iron was simply "an iron," the merchandising department had a difficult time in getting orders for even a small production. Several advanced ideas were incorporated in the design but to the dealer and public there were no points sufficiently distinctive. The dealer was sold on other lines and could not be persuaded to add still another to his stock, nor to throw out the established line and replace it with the new, particularly when the latter cost him more and was not likely to be called for by the public since no national or other advertising had been started or planned.

At this point, if the proper relation had existed between the engineering, production and marketing departments, some results might have been obtained and some progress made to solve the problem. But eight years have passed with no material change. If the selling end made a suggestion or request, the development men took it as a reflection on their intelligence and absolutely refused to consider the changes, or they filed the idea away for *future* reference, or they did the opposite of what was suggested. In the way of making up and carrying stock the same friction was exhibited. When some live work was done to dispose of the goods the production department took an aggravating long time to fill the order. A number of good suggestions were made to the development engineers and factory manager that would have helped materially in making the line a little different and would have made any publicity react directly to this line instead of to general appliances.

FACTORY MANAGERS SHOULD KNOW SOMETHING ABOUT MARKETING

The above case is cited to indicate that it is important, if not absolutely essential today, that the factory manager be broad-minded and experienced not only in production but preferably in analyzing the field in which the product of his factory is used, and knowing marketing, merchandising and sales promotion work. A man with such experience and with a good technical education or training has the basis for an ideal factory head.

Too often the factory manager and workmen seem to look upon the disposal of the product as unessential and will fuss about some small detail, entirely overlooking the selling of the goods, increasing the business and satisfying the purchaser—all of which mean greater profits and a more firmly established business.

Too often do we find factory managers who want a thing made the way they want it, believing the purchaser does not know what he wants, which is somewhat like the "public-be-damned" attitude of large public utility companies only a few years ago.

With the proper coöperation between the departments that develop and manufacture, and those that dispose of the product the biggest and most profitable results are obtainable. A plan to bring the men of these departments together at times will help to eliminate little antagonisms. If an idea comes in from Fred Smith of the southern office, it will receive more attention if Fred Smith is personally acquainted with the works' force.

If the outside men are brought into the factory periodically they will realize the conditions and limitations of manufacture and will not be so liable to make foolish suggestions, nor be so willing to offer to some fussy prospect something a little special just because this prospect wants it and not because the standard line does not offer a product that will meet the prospect's needs. If the heads of the shop departments will get in touch now and then with the user of the products and the marketing departments, they would also realize more strongly the fact that goods are made to sell, and that the purchaser must be interested, attracted and satisfied.

In conducting its business every factory should have tentative plans pointing out the possible development of all of its separate lines. Each line should be carefully analyzed; the field of use charted; competitive apparatus studied and characteristics noted; and production requirements covering stated periods estimated.

If it is decided to make a special drive on any one line or on a number of lines, the above data can be gathered in a portfolio with additional outlines of the promotion, sales and advertising work, and the results to be accomplished. This will require greater production on the line or lines selected and, therefore, the production department as well as the selling organization should receive complete outlines of the campaigns not only to prepare them but to get them into the spirit of the proposition. Charts showing periods of year when campaigns will run can be employed with the desired productions indicated.

At intervals, and by means of questionaires, the outside force can be made use of to check up such points as may show whether new lines could be disposed of in the particular field selected or whether certain changes in design seem to be warranted or necessary. Particularly in products of a technical nature and those used in industrial plants, the above mentioned coöperation between the works' manager and the selling organization, is essential—but it is important enough for serious consideration in any line. Without it any plant is handicapped.

58,000 Square Feet of Floor Space in 30 Days

WITHIN 30 days the National Cash Register Company of Dayton, Ohio, added a new building to its group of 20. It was needed to relieve the congestion of the wood-working department of the plant and to take care of demands incident to war work.

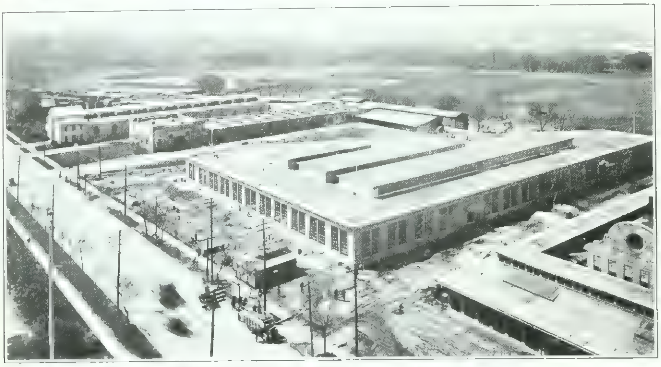


FIG. 1. NEW BUILDING OF NATIONAL CASH REGISTER CO., DAYTON, OHIO

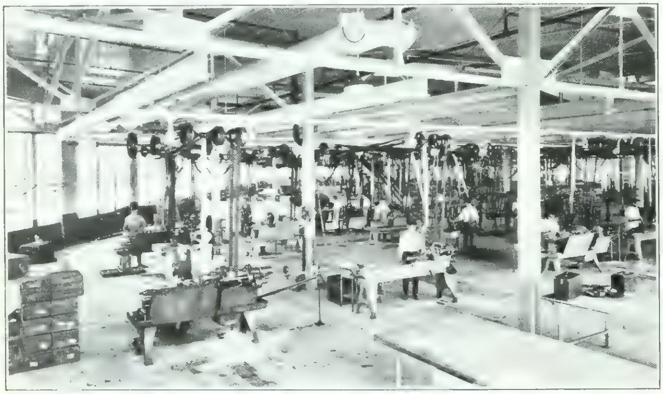


FIG. 2. INTERIOR OF NEW CASH REGISTER FACTORY BUILDING

Figure 1 shows its exterior, its general dimensions are 228 x 341 feet and it contains 58,000 square feet of floor area.

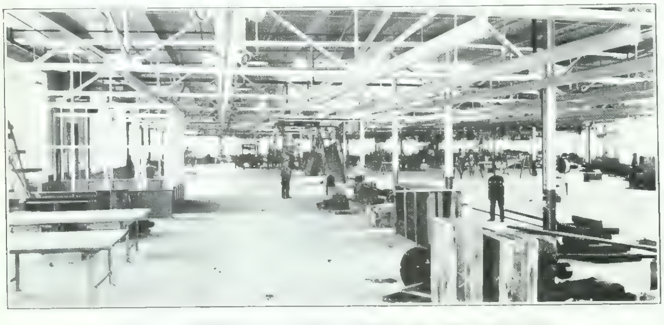


FIG. 3. ANOTHER VIEW OF INTERIOR OF NEW BUILDING

The type of construction is what is commonly known as composite, the steel structure is the Austin Standard No. 3 factory building with the outer walls of buff colored pressed brick. The general interior construction is well shown in Figures 2 and 3.

Projecting above the roof of the building, which is a one-story construction, are three monitors, each 13 feet in the clear. In them are located office quarters for the superintendent, foreman and supervisor, together with the locker, toilet and bath rooms.

The window frames and sash are of steel and 80 per cent. of the wall area is glass, thus providing for a maximum of natural light. The floor is constructed with a 6-inch concrete base in which 2 x 4 inch bevelled edge sleepers are imbedded on 16-inch centers. Over this is laid a wooden sub-floor 1⅛-inch thick and a finish floor of tongued and grooved 13/16-inch hard maple. Before laying the sub-floor the concrete base was covered with a heavy coat of coal tar pitch to hold back ground moisture. The roof is laid of two-inch tongued and grooved sheeting supported on 6 x 12-inch purlins on 8-foot centers. The composition roofing is Barrett specification with a 20-year guarantee. The heating system is indirect and a number of the heating ducts are shown in Figures 2 and 3. Steam for the air heating stacks is supplied from the power house at a pressure of 1½ pounds. The lighting system is made up of 200 watt, 220 volt type C nitrogen filled lamps with frosted bulbs. They are placed to give a factor of approximately one watt per square foot of floor area. The current supply is 220 volts, 60 cycle.

The power current is 440 volt, 3 phase, 60 cycle. The motors are standard, and rated at 30 horsepower each.

The method of supporting counter shafts, line shafts and other overhead fixtures is best shown in Figure 2. It is substantial and accessible.

Figure 4 is a view of one of the wash rooms showing the types of lavoratories and shower baths that have been installed. It is perhaps worth noting that the floors of these lavatory rooms are of mastic.

This type of construction was adopted because it was desirable to have uniform natural light over the whole floor, and second, it was desirable to get the auxiliaries and the service department into the monitors, thus away from the machine floor and give an unobstructed working space.

The designers have worked out their problems with skill and in a way that should prove highly satisfactory to managers and operatives alike.

FIG. 4. ONE OF THE LAVATORIES IN THE NEW BUILDING.

The High Cost of Power

By C. M. Garland

Consulting Engineer

THROUGHOUT the country there are numerous power installations, particularly of small and medium size, in which the cost of power is excessive. This high cost in these installations, as a rule, is never understood by the management. In some instances they buy the best equipment that money can buy and spend much more upon an installation than is actually necessary, and yet fail completely to obtain an economical plant. Others buy the cheapest equipment possible, spend only about one-half the amount necessary to build a first-class plant, and they, also, cannot understand why the cost of power is high.

It is the purpose of this article to illustrate by examples, taken from the writer's experience, why, in such cases, the cost of power is high. The building of an installation to produce power without regard to economy, is a very simple problem. The building of a power installation to produce the maximum economy consistent with local conditions, is a very complex one.

The economy of a power installation begins on the drawing board and from the time the first line is drawn until the plant is thrown into the scrap heap, the price of economy is active, intelligent, experienced and untiring vigilance.

The examples which follow are representative, and as a rule fall into that class wherein a loss of a few thousand dollars annually in the coal bill is brought about through some error in the original design or construction. To correct this error in the original design, it is necessary to invest such an amount in changes that the interest on the investment largely offsets the increased economy in the use of fuel. In other words—the original error results in a loss that the plant must labor under through its existence. The examples follow:

EXAMPLE NUMBER 1

The management bought the best apparatus that money could buy. Their load was uniform, 24 hours per day. The owner, with the assistance of the manager and the salesman of the apparatus, engineered the work. The owner, not an engineer, had read about the great reduction in plant cost and increase in earnings that could be brought about through operating at high boiler capacities, that is, at 200 or 300 per cent. rating such as are obtained on peak loads in central-station operation. The boilers and stokers were A No. 1 and designed to operate at 200 per cent. rating continuously. Aside from a poor piping layout and a few minor details, the plant was in fair operating condition.

However, a few months operation disclosed the fact that the plant was not economical either in fuel or in upkeep. The repairs on boilers and stokers were excessive. No economizers had been installed and, at the high capacities required 24 hours per day, the flue gas temperatures were close to 600 degrees F. The plant demonstrated that while it is possible to operate equipment for short periods at high capacities and obtain economical results, it is not possible to do the same thing continuously and obtain either satisfactory service or economy in operation. A plant for full load 24 hour operation should have been designed so that the boilers would not have to carry more than 150 per cent. of rating, and economizers also, in all probability, should be installed. In the present case the installation of 75 per cent. more boiler capacity greatly improved conditions, although the fuel consumption remained about 6 per cent. high, owing to the lack of economizers.

If in the original design a less expensive and less economical boiler had been installed with economizers and the proper proportion of electrically operated auxiliaries, the first cost would have been no greater than the final cost after the necessary additions were made, and a saving of 6 per cent. in the fuel would have resulted.

In a properly designed plant under the conditions, only sufficient steam operated auxiliaries should have been installed to supply steam for raising the temperature of the feed water to a maximum of 150 degrees. The economizers could then have utilized the maximum heat in the waste gases with a minimum amount of heating surface, thereby keeping down the first cost of the plant, lowering the fuel consumption about 6 per cent., or effecting a net saving of $6,000 a year in the operation.

EXAMPLE NO. 2

In this case they bought the best that money could buy in equipment. Their service was poor and their fuel bill was 30 per cent. too high. This represented an annual loss of $21,000. The work was engineered by one of their operating engineers, a so-called "practical engineer," and the plant manager, assisted by the salesman of the apparatus. They installed hand-fired grates instead of stokers. The boilers were set too low over the grates for the fuel available, and the stack was 50 feet too short for good practice without economizers. An economizer was installed, however, and the flue connection to the economizer was taken off in such a manner as to produce an excessive amount of friction loss which, combined with the low height of stack and the low temperature of the gases leaving the economizer, resulted in insufficient draft to produce the capacity desired. The low setting resulted in the volatile matter from the coal burning in the tubes producing a high temperature in the gases leaving the boilers, a high percentage of CO and clouds of black smoke.

The results were so poor that the economizer people were called in for consultation. They recommended induced draft equipment. This was installed and connected to the economizer with a by-pass arrangement for cutting out the fan. No change was made to the original breeching. This equipment, costing roughly $20,000, increased the draft about ⅛ inch and required a 125 h.p. engine to operate. There was no material decrease in coal consumption.

This plant could have been installed properly in the first place at an additional cost of about $8,000. In the installation of the induced draft equipment $20,000 was thrown away. To have made the plant right after this expenditure meant a further expenditure of about $40,000. As the boiler settings and roof of the building must be raised and the piping redesigned. The plant had been in operation for three years, and the total loss, including the loss of fuel and the cost of the changes, amounted to $120,000 roughly.

Example No. 3

It is not an unusual thing to find a plant that is well designed and constructed but poorly operated, as this example will illustrate. The plant had been placed first in the hands of an operating engineer, who was capable enough as a mechanic but who had no idea of boiler-room economy and the principles of combustion. There was ample boiler capacity installed, but he had difficulty in carrying the load, and there were many interruptions of service due to shut-downs on account of low steam pressure. The fuel consumption was 50 per cent high. The engineer was discharged and an inexperienced technical graduate was substituted.

The technical man knew something about combustion and made some saving at the start in the fuel bill. The mechanical condition of the plant, however, deteriorated rapidly, and through a general lack of knowledge and experience of boiler-room operation the boilers and pipelines became clogged with mud. In the course of about six months' time the plant was practically out of running. A general overhauling requiring several months to accomplish brought about proper conditions of operation and an experienced operator was placed in charge. The loss in fuel during the first one and one-half years of operation amounted to approximately $20,000, and the cost of placing the plant in good operating condition was roughly $3,000.

Example No. 4

The management bought the cheapest that they could buy, got what information they could from the salesman of the apparatus, and engineered the work themselves. To avoid the cost of condensing equipment which necessitated the installation of a spray pond, they installed non-condensing equipment. The boiler and stoker combined were the cheapest and, unfortunately, also the most uneconomical. If the stoker was not discharging 20 per cent. of the fuel into the ash pit it was letting 200 per cent. excess air through the grates. The boilers were single baffled affairs and would have been satisfactory if they had been supplemented with economizers. These were omitted, however.

The combined efficiency of the boiler and stoker was under 50 per cent. While every effort had been made to keep down the cost of the plant, the pipe lines were twice the size required and steam covering was not used. The fuel consumption of the plant was three times what it should have been but the price of fuel was fortunately low. The annual loss amounted to about $15,000. It would cost $80,000 to make the plant right; $40.000 would have made it right in the first place.

Example No. 5

In the building of power plants the foundations and buildings are frequently items through which serious losses are incurred. In the case of foundations, designs for these should never be made until borings have been taken to determine the character of the soil. Contracts should never be let for foundations on a cubic yard basis without designs based on actual knowledge obtained from borings. In the case of buildings, particularly buildings of steel or concrete, contracts should never be let on a per pound basis without detailed designs.

If foundations are made too light for the soil, settlements invariably occur. These are likely to entail considerable loss. If foundations are made heavier than necessary money is wasted.

Example 5 illustrates conditions that frequently occur through the improper handling of contracts for foundations and buildings. The foundations and excavations had been let on a cubic yard basis without an investigation of the soil and without complete plans. The steel work for the building had been let on a per pound basis without detailed plans. The owners became alarmed at the cost of the foundations and the cost of the steel work, which greatly exceeded their estimates. Investigation of conditions revealed the fact that the contractors had found a little sand in their excavations and had led the management to believe that large reinforced floating foundations were necessary to carry the loads. An independent investigation showed that from two to three times the amount of concrete really required had been poured.

An investigation of the steel work showed that approximately 50 per cent. more steel had been loaded on to the building than was actually required.

The open contracts based solely on the per yard and the per pound basis, respectively, had laid the owners open to this extortion on the part of the contractor. The more the contractor put in, the more he got. A contract of this form is always an incentive to, and pays a premium on, dishonest work. It is, therefore, surprising, the number of such contracts that are executed by men ordinarily considered keen in business matters.

It is likewise equally poor business judgment in the letting of contracts for buildings and foundations to let these on a purely competitive lump sum basis without carefully made dimensioned plans, as, in this case, the contractor who dares to put in the flimziest structure will obtain the contract.

As stated in the beginning of this article, the economy in power generation begins on the drawing board. A plant that is not built right in the beginning can never be made to produce power as cheaply as a plant properly constructed. The majority of small and medium sized plants, and a few large ones, labor under burdens of the nature above described. The fault lies in the engineering, and as a rule the blame rests on the management. The average manager does not realize the expense involved in the proper engineering of a power installation, no matter how small.

The total engineering cost on small plants may easily represent 15 per cent. of the cost of the plant. On large installations it may drop to as low as 7 or 8 per cent. The writer is aware that numerous plants are so called "engineered" for fees ranging as low as 2 and 3 per cent. The answer to this is that the plants are not "engineered."

How to Find and Use Barometric Costs

A Means to Determine Fluctuations in Factory Costs When Materials, Wages and Overhead are Changing

By C. W. Starker

When the various items entering into manufacturing costs are varying as rapidly as they are at present, some system must be devised for taking into account these fluctuations in the estimated costs of product. It is obviously impossible to revise detailed costs at too frequent intervals. The author describes a system in successful use for computing increases and decreases in cost of material, labor or burden and calculating percentage for representative sizes of a line of product, which by interpolation are applied to the other sizes.

Mr. C. W. Starker *has for many years been a member of the staff of the largest manufacturing organizations in this country and he has developed comprehensive systems of costs analysis for manufacturing purposes. He has contributed to many technical journals and his articles are well known to our readers.*

NOT many manufacturing companies employing, say, over a thousand men, are so fortunate as to have an entirely unified product and so manufacture only a single article. In such cases a cost system presents no particular difficulty and the cost data may readily be maintained accurately and up-to-date at all times. But where a diversified product is manufactured covering a multitude of sizes, made from all kinds of raw materials and requiring a long series of operations performed in different departments, then the compiling of accurate cost data becomes a complicated matter, requiring a large and well organized staff of experienced cost clerks to handle it satisfactorily.

And, after the data have been compiled by several months' labor they may soon get out-of-date due to changing conditions. This has been particularly true during these last few years on account of the unsettled conditions of the raw material market. Take, for example, copper quoted in the middle of 1914 at about 12 cents per pound, it rose from week to week until it reached 36 cents a pound or more. The curve, Figure 1, is given to illustrate the phenomenal rise of product consisting to a large part of copper in the form of wire, bars or sheet, as, for instance, electrical apparatus would have different factory costs and consequently different sales price in proportion as the important raw materials change in cost. Steel, entering largely into the manufacture of electric apparatus, in the form of sheet steel laminations and forgings, has gone from around $1.50 to $8 or $10. The lower curve of Figure 1 shows the rapid rise in the price of electrical sheet steel during the period from July, 1915, to July, 1917. Cast iron, brass, tin, mica, all have been subject to such frequent and sudden fluctuations that a carefully compiled cost record is rendered useless after very short periods. In fact, the changes have been so rapid that between quoting and selling, or between the closing of a contract and the purchasing of raw materials, the price relations may have changed entirely. Inaccurate records, are not only of no value, they are worse, for actual losses may be incurred by under-estimating factory costs.

What has been said about material, applies in a similar way to the other two component parts of the item of factory cost, namely, labor and overhead expense. Labor rates have in view of market conditions and shortage of the available labor supply undergone rapid changes. Many manufacturers have granted rate increases, either outright or in the form of bonus and premium percentages. It is necessary to take care of these factors in calculating manufacturing costs, just as soon as the rate increases have been decided on by the management. In a similar way departmental overhead expenses and the *pro rata* share of the general burden have changed from time to time, in view of increased production or rearrangement of manufacturing sections, additions of new departments, etc.

It is obvious from the above that under these changeable conditions it becomes a difficult and at the same time very important matter to maintain cost figures accurately and up-to-date at all times. Taking, for instance, the case of electric motors, the field of medium sized industrial motors alone, ranging from about 2 to 150 horsepower, covers some 3000 different standard ratings with a large number of special ratings and mechanical modifications. Every one of these units consists of some 50 to 75 elements. The materials include copper ,sheet steel, cast iron, malleable iron, cast steel, axle steel, open-hearth steel plate, brass, mica, babbitt, insulating material, cables, etc. The necessary manufacturing departments include foundries for cast iron, steel and brass, forge shop, punch shop, machining departments, winding, assembling and testing departments. It is obvious that, entirely aside from the necessity of keeping down the expense of accounting, it would be a physical impossibility to have a staff of clerks revising ths entire list of operatons and materials every few weeks for all the elements of these thousands of different sizes of apparatus. Furthermore, ready means must be provided in an efficient cost system for telling the factory cost of a product under conditions as they will probably exist when an apparatus, sold on contract, is actually started in the process of manufacture and the raw materials purchased.

PRINCIPLE OF THE BAROMETRIC SYSTEM

With this end in view the so-called barometric cost system has been developed and used for a considerable period with excellent success. The basic idea is, as the name implies, to provide a flexible, sensitive method of telling immediately the influence of market and manufacturing conditions upon selling price and profits, much as a barometer indicates the trend of the weather on the basis of changes in atmospheric conditions. So far as material is concerned our purpose is accomplished by segregating first the various kinds of material used in the apparatus, giving the number of pounds gross weight for each and the base price and total value of each material at a certain date. Any corrections or revisions of these figures, from time to time, are entered in the succeeding columns, giving the date when the correction was made. Similarly we record in the table the different departments performing work on the apparatus and give the amount of flat labor cost in each department as shown in the illustration. The corrections are made in succeeding columns at different dates as may become necessary by a change occurring in the labor rates. Next we give the overhead percentages used for each department at a given date and the total amount, making again corrections as they become necessary. From these figures the total amount of change in material or labor cost and overhead can be calculated quickly and a percentage established for the total increase or decrease relative to the previous factory cost of the individual unit. With the barometric cost system a number of typical sizes or ratings are selected in a manner similar to that described in connection with a system of analyzing manufacturing costs published in Industrial Management, August, 1917.

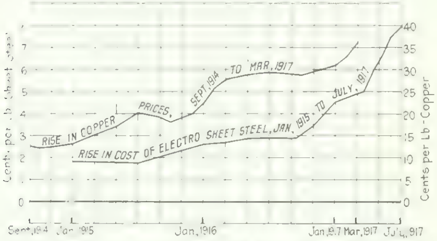


FIG. 1 GRAPHIC REPRESENTATION OF RISE IN COST OF MATERIALS

The percentages of increase or decrease are calculated for each of these selected typical sizes and it has been found that, with a uniform design and construction of all sizes, interpolation permits a very satisfactory and sufficiently accurate calculation of the new factory cost for all the intervening sizes. The main advantage and object of this barometric costs system is that these figures are obtained at a moment's notice for any condition, existing or anticipated, of the labor or material market and for any of the many different sizes. It is not intended to do away with the thorough calculation and revision of all the costs at reasonable intervals. From time to time a thorough going over of all the detail figures is, of course, required for all the typical cases selected as "barometer units." The intention is merely to lengthen these intervals and to provide a ready means for taking into account changing conditions of basis costs, so as to obtain a factory cost sufficiently accurate for use as a basis for establishing selling prices and for billing to the general stores. It is interesting to note that while in normal times the base prices of the raw materials remain fairly constant and the labor costs, if anything, require corrections from time to time, the case has been reversed during the last few years. Raw materials have soared to unheard of prices and the labor rates although very much increased have to an extent been offset by the increased value of production.

A graphical illustration usually is more striking and gives a better impression to those who do not have the time or do not care to go through a mass of figures. In Figure 2 is illustrated, as an example, assumed changes in the cost of raw material, labor and overhead, giving also the selling expense, profit and sales price at assumed different periods of the year. From the foregoing the curves will be readily understood. The values are plotted in cumulative form, that is, the vertical distances between the curves gives the amount of the particular item and these values are added to one another. The rise in cost is indicated by the difference in the length of the ordinates. Changes in prices of various materials may occur at different times as will be noted in the curves. The effect of a sudden increase in labor rates is also shown. The average overhead percentage may actually be lower due to increased production, but it will be noted in the curves that the actual amount of overhead expense absorbed, that is, the product of flat labor and the overhead percentage still shows an increase. A similar consideration applies to the percentage and actual amount of selling expense, justified by the fact that these expenses, due to general conditions, increase more than proportionately to the increase in volume of business.

As the sales price of necessity remains constant through a certain period of time, even though the cost of a product is creeping up continuously, it follows that a point is reached from time to time where the profit approaches zero and an increased price becomes a necessity. This is readily seen by reference to the curve. For the price, sales and executive departments it is very interesting to follow on such curves the changes in the cost of the product and the influence of such changes upon the margin of profit. The curves tell at a glance when an increase in the same price will become necessary to maintain reasonable profits. In these days of rapidly rising prices of practically all commodities the purchaser at times feels that the increase is unwarranted and made arbitrarily. A look at the curve will be more convincing than many words of apology on the part of the salesman. He can point to the fact that the increase in sales price is established in a scientific manner and based on unrefutable facts. It may be shown, assuming this to be the case, that as a matter of fact the increase in price has not kept pace with the increased cost of raw material and labor, even if those two items were partly offset by more efficient production and increased output.

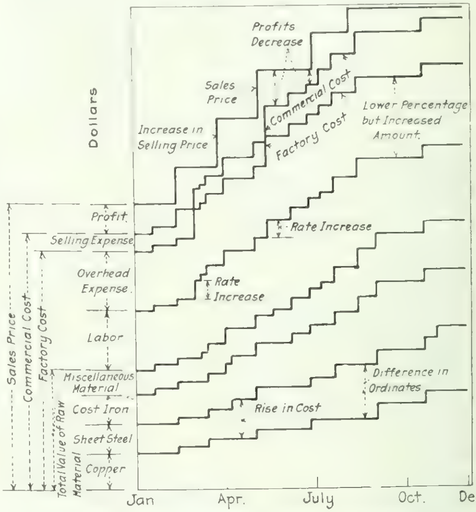


FIG. 2. ITEMIZED COST CHANGES PER UNIT

While in Figure 2 the changes in cost are shown for one unit of apparatus and recorded as they occurred from time to time, in Figure 3 is a sort of summary. These curves express the total change between the beginning and end of a certain period of time and give the change in cost for all the sizes of apparatus selected as barometric units, three for the case in hand. Such curves are particularly instructive inasmuch as they show to what extent labor, material or overhead have affected the total result—the factory cost—and also show how a change, for instance in the cost of material, affects different units. All values are plotted as percentage of increase or decrease. It will be noted that under the conditions assumed as basis for these curves, due to increased efficiency in manufacturing methods an actual decrease in flat labor costs was accomplished in spite of repeated increases in labor rates and that this reduction affected the smaller sizes to a greater extent than the larger ones. The overhead expense, therefore, although greater in percentage, showed no increase or only a slight one. As for material it will be noted that there was a very great advance in cost and that this item affected the smaller units to a greater extent than the larger sizes. This is readily explained by the fact that the larger units contain a greater bulk of the cruder materials. The curve for factory cost shows how the increase in material prices has to a certain extent been offset by the other factors mentioned, and shows how the percentage of rise in the factory cost is not uniform for all the sizes of a line, but that a lower factor should be applied to the smaller sizes. Intermediate sizes are readily interpolated, if the three sizes chosen are selected so as to fairly represent the lower, middle, and upper third of the entire range of sizes. For greater accuracy, or where variations in construction are to be considered, it is desirable to take more than three representative cases as barometer units.

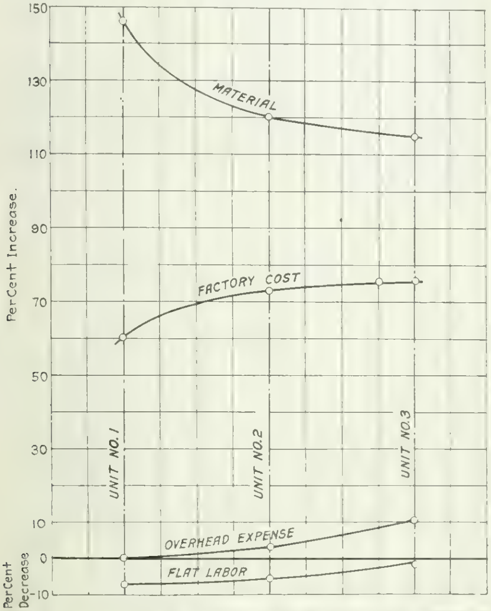


FIG. 3. SUMMARY OF INCREASES OF COST FOR THE DIFFERENT ITEMS INVOLVED

A Simple Flexible Cost System

By G. W. Greenwood

Secretary, United Fire Brick Company

DOUBTLESS all manufacturers realize the importance of knowing from an accounting standpoint where they stand, which way they are going, and at what rate.

Because of the increasing scarcity of all labor for office work as well as for every other department, every process of shortening methods of accounting and cost finding deserves consideration. An investigation into some other plan may suggest an improvement in the system one is already using.

The following plan may or may not be new, but at any rate in the years of its employment by the writer since it was first planned no accounting system so far examined has embodied it, while on the other hand systems of cost finding prepared by accountants for associations appear to go by circuitous and complicated routes to achieve the same ends.

The system is applicable to any company operating any number of plants each with any number of departments. But for illustration let us consider a single plant manufacturing but one class of material.

During the month there are incurred charges for direct and indirect labor, salaries, fuel, raw material, supplies, repairs or replacements, insurance, taxes, etc. Some of the charges may apply wholly to the month in which they are incurred, while others, such as insurance premiums, may cover a year; and taxes, as a rule, are paid in a lump sum for the entire year.

The first important step in the proposed system is this:

Charge all payments made, or liabilities incurred, in the form of operating expenses, into one single operating account, whether they apply to that particular month, or not.

A SIMPLE ILLUSTRATION

The next step is to classify these charges, and to ensure their proper distribution later. Here is an illustration which may help—In the general post office of London, commonly called the G. P. O., all United States mail, except for certain of our larger cities, is put indiscriminately into sacks and shipped across the Atlantic. Arriving here, all mail for a certain state may, with a few exceptions, be put into sacks and started across the continent. The handful of mail for a single village may later be tied in a little packet, until finally a post card dropped in a pillar box in London finds its way into a call box in a little cross roads post office in our great West. It is important, of course, that every part of the address be correct, and in addition that it should be as legible as possible.

In like manner operating charges should be identified, using numbers, letters, or symbols, that the charge may be applied to the proper department or operation, and to as remote an extent as the management desires to carry its system of cost finding. This use of symbols is, of course, well known and is extensively used by all large concerns. Its use here is only incidental to the plan under consideration.

There is one decided advantage in this system. It is equally effective if one is satisfied with costs divided into a few major groups, or if one requires the costs split into minute details.

All that is necessary is, that in the list of charges, of which the total is carried to a single account in the ledger, the identifying symbols be prefixed.

The third step, a step which may be new to the reader, is as follows: Take a sheet ruled with eight columns, as shown in the accompanying drawing. In column four, insert in black ink the operating charges in the list for the month, distributed according to the requirements of the management opposite the proper symbols, the total agreeing with the operating charge carried in the ledger for the month. Consider one of the charges, raw material for example. At the close of the month there will likely be a quantity on hand the value of which is to be inserted in red ink in column five. To show the range this system will cover, suppose there is a bill for raw material which is in dispute, the material however having been received and used during the month. If it is vouchered up or written up in an invoice journal while it is still pending adjustment, the entry may have to be reconstructed later together with necessary, timetaking explanations. If it is omitted from the current month's costs, it may seriously affect them and add an unfair burden to some succeeding month. Both horns of this dilemma are easily avoided by the system here presented. Simply insert the approximate amount of the invoice in column five, using black ink, with an explanatory foot note.

The two amounts in black, less the amount in red, give the net charge for raw material to be inserted in column seven. Dividing by the output for the month gives the unit cost for column eight.

Next suppose there has been charged up an insurance premium covering a full year. The amount properly applying to subsequent months is inserted as a deferred charge in column six, using red ink, leaving the net amount to be carried to column seven, in black.

Symbol	Inventories and Unadjusted Accounts Brought Forward	Deferred Charges Brought Forward	Current Operating Charges	Inventories and Unadjusted Accounts Carried Forward	Deferred Charges Carried Forward	Net Operating Charges	Cost per Unit
1	2	3	4	5	6	7	8
Aa			500 00	—100.00		400 00	4.00
Ab			600 00	—400.00		200 00	2.00
Ba			300 00	(×)200.00		500 00	5.00
Cm	..		900 00		800.00	100 00	1.00

Costs per unit are for convenience based on 100 units. Amounts preceded by a minus sign (–) are to be inserted in red ink. (x) Unadjusted invoice of A B Co, amounting to about $200.00, showing how such accounts can be taken into consideration while they are not ready to be entered.

Thus is avoided the plan, rather extensively used, of carrying a separate insurance account in the ledger and of transferring a fixed amount each month from it to the current operating cost account.

Next, suppose that during the month some extraordinary repairs have been made, the cost of which should properly be distributed over several months. All that is necessary is to insert the deferred portion in column six, in red.

These instances will give some idea as to the flexibility of the system. The ledger is spared unnecessary burdens. No series of closing cross entries is required.

Some of the Advantages

Here is another advantage: In making up unit costs, it may happen that one cost is abnormally high or low, and upon investigating an error may be found. This can be adjusted by using one of the columns, five or six, with an explanatory foot note. There is no necessity, so far as the costs are concerned, of recasting the previous entries or making supplementary entries.

It will be apparent that the items in columns five and six are to be carried to columns two and three for the following month, the colors of ink being reversed, so that a deferred charge or an inventory at the close of any month becomes a charge against the operations of the following month, and that there is always a complete tie up of the cost system with the ledger.

The object of two different columns, five and six, for practically the same end, that of modifying the charges in column four, is to keep the inventories and the unadjusted accounts separated from deferred charges. If care is exercised in collecting the totals of these columns and in making the recapitulations, all these items may be put in one column, so that there is but one column instead of columns five and six, and also, of course, only one column in place of columns one and two.

In speaking of the totals of columns, we refer to algebraic totals where there are contra items in the same group. This is all the more easily handled when one uses a machine which will both add and subtract, thus facilitating the work of totalling columns and of finding the net amount for column seven.

Since a deferred charge has the same effect on the net balance as does the inventory of finished or semi-finished matrial, supplies, etc., it may not be apparent why it is advisable to distinguish between them. But they are not the same kind of an asset, by any means. A deferred charge for taxes, or for extraordinary repairs and replacements, would not be a tangible asset in case a concern went into the hands of receivers.

The system above outlined can be applied—and by the writer is applied— to a company operating different plants and having different departments in those plants, with decided reductions in the actual work of accounting and cost finding, and with the introduction of a flexibility which enables one more clearly and more truly to portray his costs.

The Present Fuel Situation

By F. F. Uehling

Secretary and Treasurer, Uehling Instrument Company

It is recalled by all who are in any way familiar with the subject that the fuel shortage of last winter, the present shortage, and the shortage that we will face next winter, which may be many times more serious than last, was not, is not and will not be due to an actual shortage of coal at the mines. We have a supply at the source that will meet every increasing demand for generations, whether it be for bituminous or anthracite. We must, therefore, look to the real cause of the deficit and try to realize in time the seriousness of the situation we are bound to meet during the coming winter, if the proper steps are not taken immediately.

The scarcity of any commodity depends primarily upon three things, namely, the supply available at the source, the consumption, the transportation facilities. Insofar as coal is concerned, there is no question about the available supply at its source, therefore we must confine our thoughts to its consumption and means for transportation to the consumer. It can be said that the transportation of fuel and its economical consumption are the keystones which must sustain the entire pressure of the situation, and thus they represent two of the most important subjects before the industrial world today. These two phases of the fuel question necessitate the attention of the country's most able fuel economists and transportation experts. Their undivided efforts, coupled with the sincere and honest coöperation of all concerned, must be exercised immediately to the fullest extent, and the necessary coöperative work extended throughout the duration of the war, if the increasing demands on our industries are to be met.

Production Depends Upon Coal

Our gigantic industrial machine on which our Army, our Navy, our Allies and our final destiny depends, is in turn almost entirely dependent upon an adequate supply of coal. The necessary fuel, which represents the fundamental source of our energy, must not only be supplied in the required quantity, but of even greater importance, under existing conditions it must be furnished at the highest possible standard of purity, and consumed with the greatest possible degree of economy. We are today fighting, not a national war, but a world war, a war which will depend for its final outcome upon the resources of the western hemisphere. The greatest demand is naturally made upon the richest and most productive resources. This means that the United States with her recognized industrial and financial supremacy is depended upon to meet the tremendous requirements of the world conflict, and to bring the final battle for "Life, Liberty and the Pursuit of Happiness" to a speedy and successful end. The demand on our industries which are already the greatest in the history of the world, will be much greater as the war continues, and in all probability still greater when victory has been established. Material and energy now expended in the destruction of our enemy will later be required to rehabilitate our Allies, who have suffered so materially through his ruthless methods.

The facts of the case, no matter what viewpoint one may take, are that the demands on our industries are already greater than can at present be supplied, and that the demands are increasing with exceptionally large increments. To meet a situation which is of such importance to us, and to maintain the glory and position which our efforts will have won for us when the war is over, we must cast aside and condemn forever the extravagance and carelessness which always seem to predominate in an atmosphere of plenty.

The primary causes of our serious fuel shortage are scarcity of labor at the mines and insufficient transportation facilities. Each of these can be materially reduced in their effect, if not entirely eliminated, by the proper expenditure of time and effort during the present summer months. Neither of the above causes can, however, be treated in a direct manner. Our man power is needed in the trenches as fast as it can be trained for this heroic work, and the longer the war lasts the more will the available men for working our mines be depleted. We can therefore not count on much improvement insofar as increased man power is concerned unless radical legislation is effected whereby our men at home are compelled to serve where they are needed most.

Lack of Transportation

The lack of insufficient transportation facilities is just as serious. It is true that increased equipment is being provided as fast as possible, but the requirement of our rapidly growing war machine, combined with the requirements of our Allies, are also increasing at a tremendously rapid pace. We must then confine our thoughts and efforts to ways and means whereby the required fuel will reach its proper destination, with the assumption that transportation equipment will not be more available for coal between now and next spring than it is today. With this assumption in mind, and the Government doing everything possible to provide additional equipment, we will be working with a sufficiently safe margin to assure an ample supply of coal for all who need it.

In following out the above idea, which has undoubtedly been in the minds of many engineers, it will be necessary for the fuel economist and transportation man to coöperate in every possible manner with the Fuel Administration which has already done such wonderful work in preparing to meet the expected conditions. The above three important factors must, however, work hand in hand, for the problem has not yet been solved and there are only a few short months available before next winter sets in. The transportation expert must not leave a single stone unturned in his efforts to anticipate the transportation requirements and to provide the necessary facilities to meet them on time. The best men in the country should be detailed by the Government for this important phase of the work. This will provide the margin of safety above referred to.

Work of the Fuel Economist

The fuel economist, on the other hand, must look at the situation from an entirely different angle. He is not a transportation expert, and must make use of the transportation facilities as they exist, and can only take advantage of improved shipping conditions as they are made available. He can, however, coöperate with the transportation experts through other channels, and with him provide the necessary coal to "Keep our home fires burning" and our industries up to their required capacities throughout every month of each year during the remainder of the war. The best combustion engineers that the country affords should be conscripted, if necessary, and put to work with unlimited authority on the problem which must be given undivided attention if very serious conditions are not to be expected during the coming winter months.

In normal times the quantity of the coal that was shipped to the consumer was governed by his demand for a fuel that would best meet his requirements and his demand, except where affected by unwarranted monopolies, was in turn met through the governing factor of competition. During the past year conditions have been materially changed. The consumer has been compelled to take what was shipped to him, or go without. The miner has taken undue advantage of the situation and has transported material which in normal times he would have been unable to get rid of. Coal which should contain not more than 10 per cent. of ash was shipped in numerous instances with a content as high as 40 per cent. or more, and coal with a 30 per cent. ash content has been a common occurrence. By eliminating the unnecessary impurities which have consisted of almost anything from slate to stone, and actual Mother Earth, we could by this method alone provide sufficient additional car space to take care of the anticipated shortage for the coming winter. It is not only the criminal use of valuable car space for so large a percentage of material that is absolutely valueless, but a voluminous report could be written on the millions of dollars worth of damage done to equipment and loss in production through the use of fuel that has been and is still being forced upon the consumer.

Penalties for Dirty Coal

It is pleasing to note that the Fuel Administration has already given serious thought to this important phase of the subject, and by imposing fair and just penalties on the mine owners (the effect of which will soon be felt as the work goes on) it will be realized by the coal consumer that profiteering of a nature that affects the production of our country's industries cannot be tolerated under any circumstances, and particularly not when we are fighting a war.

As an illustration of steps that have already been taken, it might be well to refer to a paper read at the spring meeting of the A. S. M. E. by Mr. E. L. Cole, Secretary, Conservation Division, Federal Fuel Administration for Pennsylvania, wherein he states that during the inspection at destination a car of buckwheat containing 45 per cent. impurities was delivered at a textile mill in Philadelphia. The fireman was unable to keep steam above 55 pounds, the normal steam pressure being 80 pounds. Production at the mill fell off 30 per cent. and the cost of removing ashes increased 300 per cent. The coal company was compelled to rebate to the mill owner 50 per cent. of the cost of the coal, together with an equal percentage of the freight and cartage cost.

He further made it known that operators who delivered coal containing excessive amount of impurities have been subjected to various penalties. Some cars were ordered hauled to the dumping grounds in Philadelphia, others ordered to hospitals and non-profit making institutions. A few cars were delivered to churches. Many cars *en route* to the market were diverted back to the mines. In all cases the producing companies were compelled to pay the freight and cartage charges and donate the coal. This action by the State Fuel Administration had a tremendous moral effect upon the producer, and strengthened the arm of the Federal inspectors at the mines because publicity was given to each case. Many bituminous, as well as anthracite operators, have also been closed because of the inferior fuel shipped therefrom.

All that is valuable in a carload of coal is the heat it contains, and the lower its percentage of ash, the greater will its heat value be. In addition to this, if the allowable ash content in the coal leaving the mines were decreased by only 1 per cent., we would provide an additional supply of fuel amounting to more than 6,000,000 tons. To put it in another way, by insisting on an increase of only 1 per cent. in the combustible of our coal as loaded at the mine, we would increase our shipping facilities by 16,000 to 20,000 cars each month. Furthermore, all the above would be accomplished with practically no increase in the required labor.

Waste by the Consumer

Although it is quite possible that the expected shortage could be met by regulating the quality of the coal shipped from the mine, there is still another channel open to us, and it will lead to the criticism of the consumer with terms that under present conditions should shame him as much, if not more, than the first offender at the source. The miner can, of course, be accused of clogging the shipping facilities with impurities, and in addition getting a price for absolutely valueless material at the regular coal rate per ton, which today is higher than ever before in the history of the coal business. The consumer, on the other hand, in the utilization of this essential commodity unnecessarily wastes from 30 to 50 per cent. of it at its destination. It is hard to say which is the more serious offense. But it can be said without the slightest question of doubt that on the restriction of all these offenses and the proper punishment of the offenders, if necessary, depends the adjustment of the entire situation.

Managers of industrial plants are inclined to give nearly all of their attention to increased production and thus forget the importance of economy and conservation. This is particularly true at a time like the present when the demand for their product is growing by leaps and bounds. Their annual fuel item, whether it is \$5,000 or \$500,000, is often considered a small and inconsequential amount when compared with the rest of their operating expense. The installation of equipment that will even pay for itself a dozen times over the first year, is nine times out of ten indefinitely postponed unless it has a direct bearing on increased output. The sidetracking of any proposition that will pay 50 to 100 per cent. or more on the investment, is short sightedness. The facts of the case are that in the majority of industries the power plant is not given the technical attention which it deserves, yet in the boiler room where the coal is actually consumed, there are more possibilities for high percentages of saving than in any other part of the plant. Several volumes could be written on "Where and How to Save Coal," but space will only permit mentioning in a general way the two most important losses. They are, first, the loss due to improper combustion (burning coal under steam boilers or in any other process of combustion) and, second, the loss due to the extravagant use of steam after it leaves the boiler.

With particular reference to combustion the biggest individual loss is the sensible heat energy wasted up the chimney. This item alone in the average plant represents considerably more than 25 per cent. of the fuel consumed. The actual combustion of our fuel in the furnaces of our many plants is a fundamental reaction that first liberates the energy which has been stored up for us by nature in a piece of coal. On this energy depends our prosperity and more than that, on it today depends the satisfactory operation of our war machine and the final victory of democracy against autocracy.

The first steps which the coal consumer must take is to provide the means whereby he will know what he is doing and thereby put an end to guessing. With particular reference to the two important losses above mentioned, it should be remembered that there are instruments on the market that will continuously indicate and record the actual fuel wasted up the chimney for every minute of the 24 hours, so that an autographic record of any change in the magnitude of this important loss can be kept on file for every day of the year. Instruments for measuring in the same manner the actual flow of steam to any department, process or machines are also available. Thus there is no excuse for any plant in not knowing what the actual conditions are, and by the autographic records above mentioned, the results of any changes and improvements will be on file, not only to satisfy the owner with a complete history of his improved fuel economy, but also to present as *bona fide* evidence that he is doing his bit to conserve the most essential commodity of the hour.

The Operator's Questionnaire

Again, to illustrate that the Fuel Administration means business in dealing with the consumer of coal as well as the producer, reference should be made to the questionnaire which will reach the owner or operator of every plant consuming fuel. The object of the administration is to find out what the coal consumer is doing to economize so that definite action can be taken accordingly. To state the businesslike method of procedure, the writer can do no better than to quote from an article entitled "Federal Inspection of Power Plants" as follows:

> Arrangements have been made whereby inspectors of the steam boiler insurance companies, state factory inspectors, engineering students from technical colleges, volunteers and others will visit these plants and verify the answers given in the questionnaire. Each plant will be given a rating, based upon the data so obtained. The ratings will be divided into five classes, and in case of a fuel shortage, the plant that has been found to be needlessly wasteful will be one of the last to be allowed to draw upon the available supply.

The Government further states in reference to the persistent waster:

> Why should this man be allowed, through simple carelessness, to burn twice as much coal as he needs, making his product (if its selling price is based on its cost as it should be) cost more to its users, using up many-power and railway facilities to get coal to waste while others suffer for the want of it?

The writer in conclusion wishes to repeat with emphasis that the compulsory shipment of fuel with the least possible impurities, and compulsory economy at the point of consumption, together form the only practical solution of the situation. Every possible coöperation must be given the Fuel Administration. The importance of its work cannot be overestimated, and its plans must be executed during the summer months, if the vitally necessary results are to be expected.

The average production of bituminous coal per working day (five-day week) is estimated at 2,052,000 net tons, slightly lower than the average during the week of June 29th of 2,057,000 net tons and 11 per cent. greater than that of the week of July 6th, 1917.—*U. S. Geological Survey.*

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Getting the Foreman's Coöperation

By William F. Johnson

Service and Employment Manager
Taylor Instrument Companies

THE problem of the relationship between the foreman and the service and employment manager is summed up in the one word, "Service." To be successful, the employment manager must convince the foreman that one of his chief reasons for being in the organization is to serve him *for the good of the industry* through assisting him in his problems of personnel.

One of the most sacred functions which the foreman has held before the advent of the employment manager and upon which, until recently, he has believed much of his success depended, was that of hiring and firing. Quite naturally then, when an employment department is instituted, he will look upon it with disfavor as an institution to rob him of one of his privileges. Immediately then the employment manager faces an herculean task to justify his place in the organization. So it will be wise for him to make haste slowly.

The foreman in the beginning cannot be blamed for his attitude of hostility toward the employment manager, for he does not know what the employment manager's duties are. The sooner the foreman is educated to the wisdom of having an employment department, the easier will be the task of the employment manager. The cards must be placed on the table, so to speak, for the inspection of the foreman if the spirit of antagonism is to give place to coöperation.

GETTING ACQUAINTED

To follow out the development of the spirit of coöperation the tactful employment manager will spend the major part of his time during the first few weeks in getting acquainted with the foremen. He will learn of their individual problems and study their personal characteristics. He will endeavor to get their viewpoint by learning what they have been doing, so that later they will be more able to understand him when he presents his. The personal equation enters so much into the success or failure of the employment manager's work that he cannot place too much emphasis upon this point. A few weeks of preliminary missionary work will have resulted in better acquaintance with the foremen and a better knowledge of their problems, so that the time will then be opportune to call a general foremen's meeting.

BUILDING THE FOREMEN'S ORGANIZATION

The organization of the foremen's group may be along various lines. In the Tycos plan, where the idea of getting together was new, it was thought advisable, in order to bring about a greater coöperation, to include the superintendents, department heads or foremen, and the older sub-foremen. In the beginning the organization embodied 96 individuals. After somewhat over one year's progress it has now grown to about 110. Since its inception the organization has been meeting monthly, these meetings being held in the factory dining room. Immediately after working hours the group, as guests of the firm, gather about the tables to partake of a fine supper. The officers of the company always attend; in fact the meetings are more like a family getting together than a gathering of a business-like nature. The usual program at the meetings proper is first the discussion of the business topic, and then a social program which naturally varies. Music is furnished by part of the Tycos orchestra.

The purpose of the various meetings from the very beginning has always been primarily to develop the spirit of good fellowship among the foremen, to give the company an opportunity to place before this body helpful plans and obtain the viewpoint of foremen on any policy which the firm might contemplate.

Though each meeting has played an important part in the development of the Tycos group spirit, the larger reason for success lies in the proceedings of the first two meetings; those following have been in the nature of stepping stones. Had they not been so successful, the organization surely could not have reached the development it has.

OUR FIRST MEETING

What assistance the foreman could expect from this department and what the policies of the company would be toward it was fully set forth at this first meeting. In the development of this topic two points were presented by the employment manager; first as a result of his month's study, a review of the duties the foremen were performing. The more important of these were general departmental supervision of production, machine maintenance and discipline, the setting of feeds and speeds, the burden of instruction of new employees, the determination of order of work and process, the problem of keeping the percentage of scrap at a minimum, and the responsibility for engaging and maintaining the work-force. Placing this analysis before the foremen caused them to realize their problems in a clearer way than they had previously done, because they were virtually swamped with their manifold duties.

The second point developed was the benefit which would come to each foreman if he availed himself of the service of the employment department. By centralizing the engaging and dismissal of the work-force in this department, not on the initiative of the employment manager, but from instructions of the needs as furnished by the foreman, it was shown that the following results would tend to be brought about in their relation to the industry, the foremen and the workers.

First, by scientifically studying the requirements of a job, then analyzing individuals in an attempt to find out what type best filled these requirements, thus seeking to place "round pegs in round holes," the result would be that men became better producers and the foreman's production rating raised.

Secondly, this procedure would save the foreman more time in following up new men than did the older way of snatching in a hit-or-miss fashion the first applicant who came along, only to release him if he did not fit into the job.

Third, that when the employment manager engaged the working force additional time was saved to the foreman for production supervision, time that heretofore he was compelled to spend away from his department in order to interview applicants, usually during the first hour or two of the morning, the very hours so essentially important from the standpoint of initiating the production of the day.

Fourth, the assistance to the foreman in maintaining discipline in his department if the final decision of dismissal rested in the employment department, for no longer could the dismissed employee have grounds for voicing in rather uncomplimentary terms his opinion of the foreman in the presence of his fellow employees.

In other words, this procedure relieved the foreman of being the goat in such cases.

Fifth, that dismissal from the organization to be of real value should be of a solemn nature and a prophylactic measure to build up an efficient work force, as well as a means of eliminating the non-producers and stemmers of efficiency. To be effective in this respect the employees must be brought to realize that the act was one of keen deliberation and patience, and, therefore, justifiable. Thus the element of fear, the destructive force in industry, is minimized and the constructive force of hope in finding a real and growing place in the organization is developed.

Sixth, that the final decision on dismissal, when vested in the employment department, often saved the foreman against himself, in that it tended to obviate unwise hasty action on his part for which he was later sorry.

Seventh, that in the existence of any grievance between the worker and the foreman it was not commensurate with the spirit of fair dealing to have one individual act both as complainant and judge in the case, and that when the employment manager as the third and disinterested party was called in, many fancied grievances were cleared up.

Eighth, that when the employment manager interviewed all quitals not only could many valuable workers be saved to the organization, but by obtaining data as to the causes of quitals, steps of immense value toward the elimination of the causes for leaving would be taken.

All doubts as to the benefits which would result from coöperation with the employment department were thus swept away, and practically all present came forward to clasp hands with the employment manager and to express their willingness to coöperate. Many said they were certain the department would fill a long felt want. Best of all, however, was the atmosphere of good fellowship which filled the meeting. This spirit was accentuated in the social program, including the dancing.

Our Second Meeting

The second meeting was given over to the illustration of the cost of labor turnover. Charts were used to bring forth more vividly the loss which resulted, implanting a clear belief in the minds of the foremen that the employment department was a necessity, not a luxury.

The problem of labor turnover was treated from three angles. First, it was given from the standpoint of its cost to industry. Such items as the actual cost of engaging the working force by the employment manager or the foreman, as the case might be, the cost being greater in the latter case, plus the cost of medical examination, cost of reduced production which necessitated excessive plant space, equipment and supervision, added wear and tear to tools and equipment, cost of high percentage of scrap, the cost of accidents to new men resulting from their ignorance of plant safety measures, and the cost of instructing the new men were emphasized. Second, it was presented from the standpoint of the worker, treating principally of the cost to him from time lost between jobs and of frequent moving from one part of the city to another or from city to city. Third, the cost society was compelled to pay was briefly outlined, such as decreasing efficiency of production due to the constant shifting from job to job, causing ill feeling, discouragement and bitterness among the workers, the relation of this decreased efficiency to our present war needs, and, lastly, how much society was compelled to pay of the cost of the burden of inebriety and pauperism resulting from the turnover evil.

The spirit of good fellowship which took birth at these two meetings has continued to grow until now there is no difficulty experienced when a worthy measure is presented for approval. The introduction of new methods has been well received. It is believed this would not have been possible had it not been for the success of the first two meetings.

Results of the Foremen's Organization

As a result of the Tycos foremen's organization it has been found: first, that there is a spirit of coöperation and good fellowship which has grown through the ability to gather together and discuss the problems of one department in its relation to another. Through having become better acquainted with each other, a foreman now in seeking work which has been promised to him at a certain time by another foreman goes about it in a good spirited way in upholding the second foreman to his promise, instead of the old way when they more or less came to swords points over difficulties.

Second, the spirit of coöperation has not ended with the foreman's group. Before the organization was a year old the spirit of pulling together had become so contagious that it had spread to the employees as a whole. It has manifested itself in the form of the Tycos Fellowship Club. This club was organized three months ago and already has enrolled two-thirds of the workers of the plant. Its function is to initiate and conduct all the social, recreational and other activities of the employees. It has already made a good beginning in the development of the spirit of comraderie, and its future appears bright.

Among the plans for the continuation of the spirit of good fellowship in the foremen's group during the immediate future, the following have already been definitely or tentatively planned. Mr. W. J. Kibby of the C. E. Knoeppel Company is to continue his series of talks on the general theme of getting together. To date these have proven interesting and helpful. Among the topics for discussion to be considered are the problems of unsteady flow of work between departments, the causes and remedies of absenteeism and tardiness, the difficulty of getting help to stay at certain work, and the advisability of departmental meetings for the education of the employees in the steps of the manufacture of an article and its use in the commercial field.

Employing the Employment Manager

By One of Them

WE hear a lot of talk nowadays about the scientific selection of help and the need of educating foremen and department heads regarding the more modern methods of employment, but there is one phase of this question that the educators have almost entirely overlooked—that is, the education of the management to more intelligent methods of selecting employment managers.

During the past four months the writer has been endeavoring to make a new connection where salary and opportunity are commensurate with growth in ability. His experiences in interviewing presidents and general managers have convinced him that if the average employment manager used no more intelligence in the selection of help than some of these officials have shown, he would not last 48 hours on his job.

Most of the writer's interviews have run something like this:

"So you are an employment manager, are you?" asked the Big Man, leaning back in his chair and regarding the applicant curiously, as if he had suddenly stumbled upon the missing link and didn't know quite what to do with it. "Well, we need an employment manager, but I don't know whether you have the qualifications or not."

Since they had only known each other about 10 seconds, the superhuman wisdom of this statement almost staggered the applicant, but he managed to stammer out that he understood their need and that was why he called.

"Well, what have you done?" queried the Big Man, petulantly.

"At present, I am director of personnel for So-and So," replied the applicant. "And previous to my present connection, I was associated with Blank & Company for — — years."

"Hem—yes. I've heard of them. Just what do you mean—'Director of Personnel'?" and the Big Man looked uncomprehendingly at his visitor.

"In my instance," replied the applicant, "it has meant experience in the selection of employees; analysis of their qualifications; job analysis; study of labor markets and the building up of prospect files; settlement of complaints, disagreements, etc.; betterment work; industrial housing promotion; safety, health and sanitation activities; departmental organization—in short, I have come in contact with almost every branch of employment and welfare work which has to do with building up the working force of an organization."

"Huh—yes. I see," and the Big Man tried to look wise, although he *did not* see. "Well, I don't know whether you've had experience enough to handle our work. How much money do you want?"

"I think I could easily make myself worth $——— a year to you from the start," stated the applicant. "At present, I am receiving $——— a year, which is $1,000 less than I was drawing when I stepped from my last position in the ———— field. I made this sacrifice in order to get into employment work."

"Well—I want to talk with some more men before I make up my mind. I will let you know if I decide on you," and the Big Man turned back to his desk.

"If you will get in touch with Mr. Blank and Mr. So-and-So, my previous and present employers, they will be glad to inform you more definitely regarding my experience and ability," ventured the applicant.

"Huh—well, we'll look up your references if we hire you. Good day."

"Good day, sir," and the applicant breathed a sigh of relief as he stepped out of the august presence.

WHY THIS ATTITUDE?

Now the applicant did not go into this man's office with a chip on his shoulder, and neither did he go in with a hand-dog, apologetic air for taking up the Big Man's time. Rather, he tried to go in as a gentlemen and a salesman, realizing that the Big Man knew little about the goods he had to sell and ready, therefore, to demonstrate their merits and explain their desirability. Instead of meeting with intelligent interest, however, he found the suspicious, antagonistic attitude which the sophisticated business man brings to an interview with a faker.

The reasons for this attitude are still somewhat obscure, although it is possible that they may be attributed to one of the following factors:

(a) Either the management in the average organization has not been completely sold yet on the idea of centralizing employment activities in one department and is still skeptical of its value.

(b) Or, if they have an employment department, their experience has been limited to the so-called "employment managers" who are nothing more than interviewers and usually no better at hiring and firing than the foremen and department heads whose authority they usurp.

Some may object to this arraignment on the grounds that the applicant was a poor salesman and did not approach the Big Man properly. Now the applicant realized that, had he wanted to act the boor, he could have forced further details of his record and accomplishments down the Big Man's throat. He felt, however, that such an action was hardly becoming in the class of executives he aspired to and he left the Big Man's office with a feeling of righteous indignation that he had been given no better opportunity to prove his fitness for the vacancy.

In nine such interviews, the writer found only one occasion where the Big Man yielded to his plea to look up his record and, in that instance, he was immediately offered the position, but eventually refused it because the opportunities for future growth were too limited by the size of the concern.

THE SUCCESSFUL YOUNG GIANT

The writer is unfortunate enough to look like the common, ordinary run of men. He has no beetling eyebrows, no flashing black eyes that pierce you through and through, no curly brown locks—nor does he stand six feet two in his stocking feet. Yet, in an endeavor to obtain a coveted berth, he lost out to a young giant with a pleasant smile and absolutely no employment experience, because his competitor "looked the part, don't 'cher know!" as the manager of the company genially explained.

Ye Gods! If employment managers are to be selected like actors, because they "look the part," of what avail is all our study of personnel functions, of more scientific methods of selecting help, of ways and means to reduce labor turnovers, etc.?

Would it not be better to select the employment manager on a competitive basis, granting that he is the equal of his competitors in character, personality and ability? Let several of the most likely applicants go through the plant and make a survey of the employment situation, analyzing its problems and outlining the steps they would recommend to take care of them. From the respective reports of the various applicants, it should be comparatively easy to choose the one which has shown the most intelligence and the most comprehensive grasp of the employment situation of a particular concern

A Suggested Questionnaire

If such a method does not appear feasible, give them a questionnaire to answer which will indicate the breadth of their grasp on personnel matters—for that counts more than years of experience in the old methods of hiring and firing. As a suggestion for such a questionnaire, the following queries are given. While they do not cover the whole field of personnel endeavor, they are sufficient to indicate whether the applicant under consideration has a comprehensive grasp on employment matters or not. Naturally, such a questionnaire can be varied to meet the individual needs of an organization. The relative value of the answers, the Big Man must decide for himself.

1. What do you consider the most essential qualifications of the successful employment manager?
2. What is the ultimate purpose of all employment and personnel activities?
3. What method, or methods, do you consider the most desirable in the efficient achievement of this end?
4. How would you install these methods?
5. Outline your conception of the ideal personnel activities.
6. Which of these phases of personnel endeavor do you consider the most important?
7. Which are absolutely essential to the beginning of any personnel activities?
8. What is the relation of the employment department
    - (a) To the management?
    - (b) To the men?
9. Outline your conception of employment functions.
10. Do you think an employment department should exercise an arbitrary power of hiring and firing?
11. If not, how should this problem be handled?
12. What method, or methods, do you consider the most efficient in selecting
    - (a) Unskilled labor?
    - (b) Semi-skilled labor?
    - (c) Highly skilled labor?
    - (d) Office and clerical workers?
    - (e) Executives?
13. What knowledge is necessary before such selections can be properly made?
14. What do you consider a fair allowance for error in selection by the employment manager or employment department?
15. How do you define labor turnover?
16. How do you compute it?
17. How do you determine its causes in any particular department?
18. How would you determine its remedies?
19. What general factors do you consider most influential in reducing labor turnover?
20. How would you undertake the organization of an employment department in any given concern?
21. What form do you deem essential to start with?
22. What source, or sources, of labor can you suggest?
23. What records would you keep?
24. How would you keep and file them?
25. What methods would you recommend for handling
    - (a) Complaints?
    - (b) Disagreements?
    - (c) Transfers?
    - (d) Promotions?
    - (e) Releases?
    - (f) Pass and badge systems?
    - (g) Payment plans?
    - (h) Job training?
    - (i) Industrial training?
    - (j) General educational work?
    - (k) First aid?
    - (l) Safety activities?
    - (m) Accident compensation?
    - (n) Medical service?
    - (o) Physical examinations?
    - (p) Health education?
    - (q) Sanitation training?
    - (r) Housing projects?
    - (s) Promotion of social activities?
    - (t) General betterment work?

Suggested Answer to Question 1

Since this questionnaire is offered as a guide it is inadvisable to publish one man's views as to the proper answers. To show the scope which may be covered in answering them, however, the writer offers his opinion of the proper answer to question 1, "What do you consider the most essential qualifications of the successful employment manager?"

(a) A sympathetic appreciation and understanding of the workers' viewpoints.

(b) An equal appreciation of the management's aims and ideals.

(c) The tact and diplomacy to promote intimate and friendly relations between these two extremes.

(d) Sufficient breadth of business vision to anticipate the future and prepare for it.

(e) Analytical and constructive ability of a high order.

(f) The executive ability necessary to organize and direct large affairs.

(g) Experience in judging men—their strength, their weakness—and their fitness for any given line of endeavor.

(h) Sufficient knowledge of the operations in an organization to analyze jobs and determine the qualifications essential in the workers who are to fill them satisfactorily.

(i) Backbone enough to insist upon a "square deal" at all times—both for management and men.

(j) Last, but not least—the patience of Job!

The answers to the remaining questions can be equally elaborate, according to the applicant's understanding of the subject and conception of the proper methods of handling such matters. Answers to such a questionnaire should be written and sufficient time should be allowed for thinking them over, since few employment managers would feel qualified to pass on them off-hand.

Several advantages would result from the questionnaire method of determining an applicant's fitness for employment managership. First, the management would be able to obtain many valuable suggestions on their own employment situation; second, the collective opinions of several employment managers on given subjects would tend to establish the standing and relative values of these subjects; third, the applicants would profit through a clarifying of their own ideas on personnel matters; and fourth, the consideration of the replies so received should prove an education in the real meaning and scope of personnel activities.

Lastly, by careful comparison of the replies to such a questionnaire, the relative grasp on personnel matters by each of the applicants could be determined with a fair degree of accuracy and the management would succeed in doing what it requires its employment manager to do—it would put the right man on the right job.

Why Men Leave Their Jobs

By Henry P. Dutton

Assistant Professor of Factory Management, Northwestern University School of Commerce

WHY do men quit their jobs? What are the thought-processes and the mental attitude that lead a man to call for his time? The question is an acute one for all of us, and it was the urgency of the question in a particular department losing men rather rapidly, which led the writer to attempt an analysis of some of the reasons for their leaving.

Undoubtedly the most common, immediate cause is the chance to earn more money, or to improve the net balance of working conditions. Rumors of higher wages in other plants cause the man to use his evenings or lay off a day or two to go scouting, or he gets in touch with the recruiting agent of another plant and receives a good offer. He strikes a more or less accurate balance between the new job and the old as regards earnings, cost of moving and changing, steadiness of work, etc., and, if this balance is unfavorable to us, we lose a man. The first and recognized essential to stability of force is that we shall pay at least the local market price for labor. This is sometimes easier said than done, as those who have had to buy labor for a peace-time product in the midst of a munitions district can testify. But pay the market price for the necessary grade of labor we must.

Pay is not the only factor which enters into the man's profit-and-loss statement. Hours of labor enter. A promotion involving shorter hours for a clerk who had a long trip to and from the office, meant more real addition to his comfort and well being than a substantial raise would have done. Physical security and comfort enter. If the shop is cold Monday morning in the winter, men will leave. An elevator accident in which a man was rather badly hurt resulted in the loss within the week of two men, and the later loss from the department of one or two more. Chances of promotion, chances to learn a trade, permanence of the job, pleasant social atmosphere, all enter into the computation.

The degree to which our men will have occasion to make this financial comparison depends very largely on the relative fluidity of local labor conditions, and the habit of the factory itself. Certain factories are able to hold the major portion of their employees year in and year out, and this plant-habit aids powerfully in preventing men from being constantly on the watch for small or temporary advantages. Normally the small town is more stable in this way, but the small town is being more or less systematically exploited in the present scarcity of certain classes of labor. Also, we all recognize certain individuals of restless type who are constantly open to the temptation to make such shifts.

Quite apart, however, from the shifts which result in higher wages or other real or apparent improvement in status, we must recognize that many men leave with nothing in sight, and in the typical case, lose a month or two, and then settle into a job no better than, or not as good, as the job they left. In this class falls the "floater," who is a bricklayer today, a machinist tomorrow, a teamster or a carpenter three weeks hence. The floater belongs to a class which seems incapable of sustained purpose; their mental ineptitude or instability has forced upon them a habit and a philosophy of improvidence with its disastrous results.

REASONS OTHER THAN PROFIT AND LOSS

But many who are not of this somewhat hopeless type, leave their jobs for reasons other than those of profit and loss. Verging on this type is the man who gets tired of a job. Two young fellows were overheard on the street: "Going over to Potter Machine tomorrow." "What you goin' to do?" "Drill press." "Why you quittin'?" "O, nothin', just want a change." The conversation is typical of this class. The other side of the road always looks better, and we all hope by change to clear the account of many petty accumulated annoyances and to meet new and interesting conditions. To many men without serious responsibilities the temptation is strong.

There are many serious influences in our modern industrial life which intensify this restlessness. The American manufacturer is in part responsible, through a failure in intelligent planning and scheduling, or through sometimes inevitable trade conditions which produces heavy and often quite unnecessary fluctuations in his working force. Our unspecialized educational system must bear a part of the blame. The writer has had occasion to contrast the product of German and of American influences in this direction. Typical of the former is a machine-shop foreman, thoroughly apprentice-trained, a master mechanic who was adequately equipped for one trade and has followed it successfully all his life. The contrast with an American of about 30, whose employment record showed that he had been successively a structural shop laborer, rivet bucker, assistant bill maker in a freight office, machine tender, roofer, and clerk, emphasized the danger of a training which gives no definite bent to the individual, and leaves him free to dabble unsuccessfully in anything. This particular man was at the time considering a jump back to the freight office in routine clerical work. He had roots in nowhere.

Unspecialized training, our typical American idea, has its value in developing a percentage of strong individuals, but it falls short as a preparation for the life work that faces the average man.

Some part of this unfortunate mobility of labor is also due to the changing and more migrant type of modern life, resulting from increased facility for communication, the want advertisement in the daily paper for example, and the ease of moving to a new flat or a new town.

INADEQUACY OF MAN TO JOB

We may distinguish another common and serious reason for quitting, in inadequacy of the man to the job. Two of the great driving forces of human action are the constructive instinct, the pleasure in achievement, and the desire for approbation and praise. The man who is failing to satisfy himself in these respects, no matter how good his pay may be, works under an increasing pressure of dissatisfaction and discomfort which usually reaches a point at which the man will do anything rather than continue to face a duty to which he feels himself unequal.

The writer was much struck by a description by Major Bailey in the *New Republic* of January 5, 1918, of tests being conducted to eliminate from the army in advance, men subject to shell shock was due not so much to the specific effects of combat, as to the inadequacy of the subject to the situation—an inadequacy so serious that it resulted in temporary or persistent nervous collapse. A similar inadequacy brings men to crisis in civil life, in which they either temporarily break down or seek relief by escape. Probably most of us have been able to trace a severe cold or some other temporary physical collapse, to the necessity of some difficult and unpleasant decision, or to the pressure of a situation which temporarily overwhelmed us. Typical of this reason for men leaving was the case of a man who at his own motion was promoted to take the place of a "clearing house clerk" who had satisfactorily performed his work for two or three years and left to take a better job. The work was simple, but required a degree of speed which the new man failed to attain, and the work gradually piled up and the pressure to catch up became heavier. The new man, in spite of the raise in pay, became more and more discontented, and finally left for a less desirable position in which, however, he could enjoy his peace of mind.

Inadequacy on the man's part may not be the only reason for dissatisfaction with performance. We have all noticed how impatient workmen get with a system which hampers performance or is not efficient. If the inefficiency does not affect his own earnings, the man may tolerate it as none of his business, but the effect on morale and on his contentment with the job is bound to show sooner or later. Taylor's example of the shovelers who were hired away at higher wages, but came back because their new employers did not know how to direct them efficiently, illustrates this point. Every man likes to play on a winning team.

Pent Up Emotion

In addition to the losses which come from a failure to adjust the man and the job to each other, come losses which arise because we may have failed to consider the fundamental instincts which govern the relation of men to each other. We offend the man's pride, we submit him to a real or fancied injustice, we arouse his distrust, we excite his jealousy by showing what appears to him to be favoritism; we criticise him, as he sees it, unfairly, and there follows an explosion of pent-up or suddenly aroused emotion, the man flares out with a resignation or quits instanter. The cause may be serious or trivial, but once having committed himself, his sense of self-esteem prevents him from backing down, and we have lost a man.

It is recognized that the labor foreman or gang boss has much to do with this kind of loss. Unskilled in analysis of motives and instincts, not sufficiently removed above his men to feel assured in his authority, often too zealous for his employer's interests, often a petty tyrant by nature, in his education and regulation we find an effective leak-stopper. We may recognize the symptoms often by relative turnover of departments. The turnover of a blacksmith department was around 240 per cent., with a general average for the factory of less than half that amount. Investigation showed serious unintentional faults in the foreman's methods of handling his men. Facts brought out incidentally in conversation with the men give another indication.

A second prolific source of such accumulations of feelings of injustice, distrust, and revenge or indifference, may often be found in the policy of the firm. Underpay, failure to make good on promises, arbitrary rulings, introduction of changes not understood and misunderstood by those affected, are fruitful causes. Even-handed relative justice in promotion and preferment, as between members of the force, is important to stability.

We may then summarize these causes of loss as: failure to provide a price and condition basis on which we can compete for men; inherent instability of the man himself, inadequacy to the job traceable either to the man or the management, and real or fancied wrongs which cause an emotional outburst and commitment of the man. What are some of the possible remedies for these causes? How can such conditions be improved?

Some Possible Remedies

The remedy for an unfavorable balance in the man's profit-and-loss statement, is obvious, although not always easy of attainment. While subject to modifications in special situations and to certain difficulties with large employers, the policy expressed to the writer by a successful manager has always seemed fundamentally sound. "We aim to run our shop with good wages, a picked bunch, proud of the fact, and a fast pace."

Careful original selection and subsequent study of our men will do much to eliminate losses from inadequacy. Methods of original selection are too well known to require comment, but there is perhaps need for an emphasis on the value of judicious winnowing of the men who come in as raw material, so that we can draw from this reserve supply to build up our administrative personnel.

The best way to avoid loss through emotional outbursts is to remove the reasons for them. A system of employe records which enables us to base increases and advancement on performance, and careful rating of the man by more than one impartial observer, will save much loss. It is well to require the foreman to aid in making this rating of the men under him, not only to increase its accuracy through the intimate knowledge of the foreman, but to train the latter in the habit of making balanced and intelligent judgments of his men. Intelligent and general application of such a "merit system," automatically removes much of the jealousy and feeling of favoritism, so common a cause of dissatisfaction in organizations. It is highly desirable that uniform grades of pay and an understood plan of promotion (which may be made clear by an organization diagram), be provided to give the men the confidence and assurance of advancement that comes from aboveboard feeling.

These points touch the negative side of the question. The positive side, loyalty, must not be neglected. The keynote of enthusiasm in an organization is loyalty, personal attachment to a leader and a cause. That is why successful organizations can draw and hold good men, and is a reason for their success. In a large steel jobber's establishment one of the laborers was badly tangled up with a loan shark. He was induced to tell his troubles, the company lawyer took his case up, secured a favorable judgment, and put the man on his feet again. The next Christmas the time-study man who had engineered the case received a box of cigars and many awkward protestations of gratitude. I do not know whether he smoked the cigars, but I do know that practically every man in the shop heard all the details, and felt that he knew where to go when he got into trouble.

It is desirable to prevent the question of a change from ever arising. The more intelligent, large employers of men are more and more adopting the policy, possible in a large organization, of making every man, no matter how insignificant, feel that work with the company is a life work, and of investing the idea with as much of the professional values of dignity and social approbation as is possible, for they are beginning to realize the evils of a high labor turnover.

Methods of an Employment Office

By C. S. Rossy

Employment Manager, The Norwalk Tire and Rubber Company

THE former haphazard methods of conducting the employment department have undergone a course of reconstruction to meet increased demands, and the efficient office of the present adheres to a more or less strict routine, under which all matters are handled with a clock-like precision. It may be helpful to present here an employment system, that has been inaugurated in two plants with which the writer has been connected, employing, respectively, about 8,000 and 700 men. In both instances the plan has worked out successfully, but has been found particularly valuable in the smaller of the two concerns. It is, therefore, recommended especially for concerns employing less than 1,200 men.

Under this system "the hiring and firing" of men is taken out of the hands of the foremen and confined exclusively to the employment office. It is most important, however, that coördination be secured between the foremen and the employment manager and that the former be brought into entire sympathy with the employment office staff.

Employment Cards

When additional help is wanted in any department the foreman sends to the employment office a request, at least 48 hours in advance of the actual need. This *employment request* is a printed blank (in dimensions 4 x 6 inches) on one side of which the foreman notes the number of persons needed and the desired qualifications, such as age, education, experience, etc. On the other side of the blank, there is space provided for entering the names of the employees sent to the foreman in answer to his request. Applicants are interviewed personally by the employment supervisor, who quickly eliminates all undesirable candidates and refers the desirable ones to a clerk, who fills out the *employment card*.

This card covers information on: (a) personal facts, such as name, address, civic condition, number of dependents, religion, etc.; (b) educational training; (c) industrial record, which comprises, at the least, a statement of the last three positions held, names and addresses of employers, tenure, salary received and reasons for leaving; (d) remarks on physical condition and mental characteristics. When the employment card is propely filled out, the applicant is referred back to the employment man for a second interview, at which the latter, with the written information before him, can determine for what position the applicant is fitted.

Introduction Card

If the applicant is employed, the starting wage is entered on the space provided for the purpose on the back of the card, which is now ready for filing. The employment clerk then makes out an *introduction card*, which contains the new employee's clock number, department number, name and address, and starting rate. After the employee is provided with a clock card and pay check, he is sent with the introduction card to the foreman, who files the latter.

When an employee leaves the service of the company, or is transferred to another department, his introduction card is returned to the employment department, after a note of the reason for leaving has been made on the back in the space provided for the purpose. In case the employee is transferred, a second introduction card is made of the transfer on the employment card kept in the files of the office.

Progress Records

The employment card can be made very valuable if it is used as a progress record of the employee. Special spacings and headings can be provided for entering the weekly or monthly earnings of the individual, his increase in productive capacity, absences or instances of tardiness, the good or bad characteristics shown during the course of employment, etc. All this record can be greatly simplified by using a code system. Reports on absences and tardiness are obtained from the timekeeper's office and not from the foremen, but information about progress in work comes from the foremen.

It is desirable for the employment department to exercise as much supervision as possible over the emuloyees, especially over those persons most recently engaged. The employment card, being a concise story of the worker's industrial record, is a guide that helps the employment manager in determining what courses to follow in connection with the supervision and adjustment of the individual. A man, for instance, whose earning capacity shows a gradual decrease on the card requires attention and at once becomes a subject of investigation by the employment office. It may be that an adjustment, such as a transfer to another department can be brought about. Sometimes the records on such employment cards have been the basis for wage studies that have led to a revision of piece rates. In short, the value of this progress record system cannot be overestimated.

The question of discharges should always receive the close attention to the employment manager. Foremen are usually quite ready to discharge a man on the slightest excuse, without realizing the high cost of the labor turnover. For this reason, some executives are inclined to take this matter entirely away from the jurisdiction of the foremen. Although such an action has its advantages, it is found more desirable to have the formen refer back to the employment office such employees as he considers undesirable for his department. Whereupon the employment manager then investigates.

Regulation of Wages

As a large labor turnover is sometimes due to maladjustment of wages, the employment manager is more or less concerned with the regulation of wages in the factory. After investigation, he sometimes finds that the revision of piece rates alone can bring a marked reduction in the turnover. A particular case comes to mind where the turnover of one department was very high. After a study of the situation, a recommendation was made for an increase in piece rates. Three weeks after the increase went into effect the labor turnover decreased about 60 per cent.

In connection with employment work, there usually arises a group of supplementary activities which, belonging primarily to the employment department, in the course of time develop to such an extent that they become the foundation for related departments. Among these activities may be named matters of factory sanitation, education, accidents, insurance, pensions, recreation activities and physical examinations. In the two factories utilizing the system described herein, these activities have all been placed at the outset under the jurisdiction of the employment office. However, the larger factory has already established allied departments, which are now taking care of these activities; for instance, education is delegated to the welfare department, physical examinations to the health department, etc.

Another Source of Labor Supply

By [illegible] Hampson

WE discovered a new source of labor supply when a letter was received one morning from an inmate of a reformatory some 20 miles distant asking for work, and stating that the superintendent of the institution would sign his release upon written evidence of employment from a reputable business house. This was shortly before our entrance into the war and at that time there was no labor shortage, so the matter was tabled, but with the wholesale loss of men in the past year it opened an avenue of no little promise.

Institutions of correction number among their inmates a great many young and middle aged men who have been committed for indiscretions and minor offences—men not bad at heart, men who by their own admission have erred and been punished, and who are eager for the chance to prove themselves good and useful citizens if someone will repose confidence enough in them to give them a fresh start. The records of these men are open for inspection to anyone desiring to make a selection of help for their needs. After a certain period of detention, the officers in charge are permitted to release on parole such of the men whose conduct at the institution and past record in civil life warrant the privilege of returning to productive occupations. This parole may be for a stated period or indefinite or dependent on good conduct.

Manufacturers and farmers located near enough to institutions of this kind to allow the parolees to report at intervals will find there an unlooked for source of male help. The men of the class indicated have usually committed their crimes through the influence of bad companions or under the pressure of poverty and sickness; plants away from the congested centers of population do not have these things to contend with and the present bonus systems of payment limit the worker's earnings only by his speed. A man who has forged a small check to help out on the butcher's bill has no incentive to repeat the attempt when he can earn, say, $8 a day at piece work and hold up his head among his fellows.

Somewhat in the same catagory are a certain class of "insane" people. In insane asylums to-day there are confined thousands who are neither violent nor vicious, whose trouble is of the sort commonly called "nervous." Since the present war began there have been plenty of this class of patients confined in Government hospitals able bodied young men sick in the head. Friends or parents have obtained the release of these unfortunates in their charge and they are doing their bit in factories and on farms. Experts on insanity agree that the best treatment for these patients is occupation of a congenial form which does not tax the mind—it remains only for the employer to step forward and assist in a work that is mutually beneficial.

Book Reviews

By C. S. Rossy

Employment Manager,

The Norwalk Tire and Rubber Co.

"Hiring the Worker," by Roy W. Kelly. New York: The Engineering Magazine Co., 1918. 244 pp. $3.

In the last five or six years a new profession has appeared, which has developed with remarkable rapidity to the height of a significant role in industrial activity, and gives promise of a still greater prominence in the immediate future. At the time when a surplus of labor existed the employment manager was almost unknown; to-day, when the question of labor comes to the foreground, the employment manager becomes one of the most important executives in an industrial concern. He is the man who, more than any other, reaches the vital part of the factory's existence; having the task of selecting, adjusting, and developing the worker, he finds the life and prosperity of the organization more or less dependent upon his actions. An increasing number of industrial leaders are recognizing that the chief problem of industry is not that of raw material or equipment, but that of the human element, the worker. Scientific effort must be applied to the question of labor just as it has been applied in the past to perfecting systems of cost accounting, equipment, machinery and raw material. The profession of employment manager cannot fail to stand in the foreground when scientific labor management shows itself as the solution of many difficulties.

In the early stages of this profession it was natural that the chief function of the "employment agent" should be similar to that of the purchasing agent. As the latter procured materials for the factory, so the former procured men. Scientific purchasing requires knowledge and study of the markets, testing of material, and calculation of schemes for economy, and, patterning after the efficient purchasing agent, the employment manager also became scientific and studied all factors connected with the human element in the organization. Just there he came to the way that led him beyond the purchasing agent. In his study of factory and labor conditions, he found his duties and responsibilities continually increasing and soon realized that practically upon himself devolved the function of stabilizing the entire organization. He has now become more than a purchasing agent of labor. Only a small portion of his task is to seek and bring the human material to the gate; much more important is his subsequent responsibility of properly placing and developing the men after they have been selected.

Desiring to bring before the public some of the fundamental facts of employment management, Mr. Roy W. Kelly has conducted an investigation among several of the leading concerns in this country and in his book entitled, "Hiring the Worker," presents a comprehensive suumarization of systems that are in use. While in a few cases the office of employment manager was found to be still considered of minor importance, the majority of the concerns showed a realization of the serious nature of the problem of handling employees and were devoting special attention to the matter of centralizing all employment work.

Without doubt, the task of properly selecting the workers is the chief function of the employment manager. It cannot be satisfactorily performed without detailed analysis of the two principal factors involved: the man and the job. The employment manager must know exactly what the nature of the job is and he must find just the man that would fit the place; the undesirable results of an unfortunate selection can be many.

Employment work does not merely consist, as some people seem to think, of choosing a man from a group of applicants and sending him to a foreman to fill some position. In fact, that is only the beginning of the procedure. It is true that the skilful employment manager, aided by a thoughtfully prepared application blank, can make a fairly satisfactory estimate of a worker's abilities in the employment office, but the real test comes in the factory itself when the applicant is really assigned and working on the job. In a short time it becomes evident whether the employee is in the right place or not; the record of his ability and progress clearly indicates his aptitude for the task in question. The employment manager, by studying the record and investigating, learns whether the man has been placed to the best advantage. He has now the opportunity of educating the worker and improving his efficiency. He may transfer him or promote him, as may seem desirable.

In addition to the selection and adjustment of the employees, there are many other responsibilities that logically come under the jurisdiction of the employment department. Particularly important is the following-up of employees, and above all, those who have been most recently hired; systematic records of their production, increase in efficiency, suggestions offered, errors made, instances of tardiness or absence, etc., are valuable for investigation purposes. The employment office should endeavor to learn all reasons for voluntary quitting or discharge. Furthermore, such affairs as welfare activities, matters pertaining to health and sanitation, publications, and the leasing of houses to employees can well be handled by the same department.

To be a successful employment manager, certain qualifications are necessary. Mr. Kelly, after making his study, is of the opinion that these requisites should be named as being of special significance: keen ability to judge human nature, tact, patience, and strong will. The employment manager should be possessed of a pleasing personality and be humanitarian in concerning himself with the conditions under which the employees work, but he should have the firmness and energy necessary to carry conviction as to the wisdom of his views. Standing in an intermediate position, he must keep always in mind his duties to the employer as well as to the employees.

"Hiring the Worker" is a valuable book for all who are interested in employment questions. It gives an account of a large number of employment methods that have been put into use throughout the country; it is not based on theory but on actual conditions. The numerous blanks, forms and charts with which it is illustrated cannot fail to be of assistance to those who are contemplating the organizing of an employment department. The selected bibliography at the end contains the titles of many important articles dealing with the subject, with a short critical review that is most helpful in each case. Industrial executives will find much in the book that is of value in the line of suggestions and criticisms regarding employment work and labor turnover.

BOOK-KEEPING AND COST ACCOUNTING FOR FACTORIES. By William Kent, M.E., Sc.D. 261 pages, $8\frac{1}{4}$ x $10\frac{3}{8}$ inches; numerous forms; cloth bound. Price, $4 net. New York, 1918: John Wiley & Sons.

Reviewed by A. Hamilton Church

In the preface to this work the author asserts that the time has arrived when there is a need for a systematic treatise on cost accounting. It is questionable whether he has been wholly successful in catering to this need. While he has produced an interesting book which may with advantage form a part of every cost-keeper's library, the general effect suggested to the reviewer is rather that of a compilation than a well digested and systematic treatise. Of the 261 pages, 21 are devoted to initiating the beginner in the mysteries of commercial book-keeping, while nearly half the book is taken up with descriptions of special systems adaptable to specific industries. Only about 100 pages are thus left to be devoted to the general subject matter of the book, namely, factory and cost accounting.

While the major part of the book may be regarded as a brief and very condensed account of some of the most modern practice in book-keeping and cost accounting, it is naturally the personal viewpoint of the author on debatable points that is of most interest. On page 81 we find the caption, "The last word on Burden—Standard Burden per unit of Finished Product." Reading this paragraph with eager anticipation we find that the "last word" is a recommendation to establish first a standard labor cost for a given piece of work, then ascertain its burden by means of machine rates, and consider this burden as standard for all similar quantities, notwithstanding that actual labor costs may have varied. Examples are given on which the author himself comments as follows: "Sticklers for accuracy may find fault with these figures, one set holding that the charge is too low . . . while another set would say that we have inflated the inventory by charging to warehouse the cost of spoiled work, which should have been charged to a separate account and not to the cost of the product." A system of accounting which is open to a charge of both improperly understating actual cost and at the same time of improperly inflating the inventory can only be regarded as a very amateurish affair, and it is very small excuse to allege that by such loose methods labor in accounting is saved and that "it leads to obtaining prompt information in regard to the progress of work through the factory." It is a curious phenomenon that writers belonging to the "scientific management" school, while themselves great sticklers for meticulous accuracy in time studies and so forth, frequently favor methods in accounting that no experienced accountant would entertain.

The author also holds peculiar views on the subject of inventory values. He considers that the excellent and prudent rule that no profit is to be taken on goods merely held and not yet sold "might lead to no end of confusion in the estimation of profits and losses in a manufacturing business in times of violent fluctuations in market prices." He is apparently willing to declare dividends on the strength of a rise of values in raw material. This is a very dangerous policy to recommend, and his apparent object in entertaining such a heresy is that the base on which to figure a selling price "is not the post-mortem cost, but the present estimated cost of reproduction." These views seem derived from a general policy of regarding costs as something to be twisted and manipulated rather than as fairly close and accurate history of something that actually happened. In fact the author's own words show that he has but little conception of what cost actually is, or should be. In Chapter VI he says, "A new definition of Factory Cost is now needed. It is not post-mortem cost, what the goods cost last year, but what it now costs to produce them, or what they will probably cost during the remainder of the current year, assuming that the factory runs at a normal average rate." In other words, he confuses costing proper with intelligent inference from proper costs. Unfortunately by merely altering a definition we do not obtain a new and safe method and are very apt to fall between two stools in making the attempt.

The size of the book ($8\frac{1}{4}$ x $10\frac{3}{4}$ inches) is an unusual one for technical works, but was adopted to permit the display of tables and blanks. An excellent index of subjects, authors and blanks accompanies the text.

Electric vehicles are used extensively in five navy yards, three arsenals and several depots in hauling mail and parcel post matter, and at the various departments of the Government in Washington. Also at Panama, and in Manila. They are given preference at the navy yards for the reason of economy and freedom from fire risk.

Editorials and Comment

Mastering Power Production

WE regret that Mr. Walter N. Polakov, due to the pressure of work for the United States Shipping Board, has been unable to prepare the August installment of his extremely helpful series "Mastering Power Production." However, the series will be resumed in September.

Who Make or Break the Organization?

THE every shifting viewpoint in regard to the human factor in industry swings from the humblest worker to the chief executive as a pendulum swings across its arc. Just now our interest seems to be centering part way down the swing from the executive head and is bringing the foreman to the front.

We are being told that the foremen are the most important persons in the organization. They are the ones who interpret the policy of the management to the workers. They are the ones who are responsible for production. It is the foremen who can make or break the organization. Many industrial executives today are seeking for the most practical means to develop team spirit among their working people or, in other words, the spirit of the organization. If the foremen as a group are of such overshadowing importance in an industrial plant it follows that when we begin to create the spirit of the organization we must begin to work with the foremen.

This view is ably presented by Mr. William Judson Kibby on page 117 of this issue. Mr. Kibby brings to us the inspiration of good fellowship and the experience of many years of industrial work in foremen's meetings, from those in comparatively small industrial plants up to some of the largest in the United States.

Let us hope that the appreciation of the foremen in our industrial life will grow; let us hope that more conscious means will be taken to show to the foremen that they are a vital part of the organization, and that in reality their spirit is the "spirit of the organization."

Machine-Tool Time Studies

THE second greatest invention in the history of the world from the viewpoint of influence upon human life is said to be the lathe slide rest, a bit of mechanism that is found in some form or other in every machine tool. More than 100 years passed from the time of this invention until the measuring devices and methods of time study were applied to these machines. In fact the series of articles now appearing in our pages written by Mr. Dwight V. Merrick are the first complete disclosure of machine-tool time studies.

Looking a bit into the future we may well ask, however, if the progress in machine-tool development will not come in some degree from the widespread making of such time studies. To know in an engineering way we must measure and the scientific time study does that very thing. As applied to a machine it measures the time required for its manipulations and this is in itself a measure of the efficiency, ease and quickness of operation and capacity to produce of the machine itself.

One of the important reasons for making machine time studies is to improve the operation of the machine itself. Up to the present time only a few machine tools have been carefully and completely studied. But now that the way of doing this work has been disclosed we may hope that every standard machine tool will be subjected to examination. Some of the results obtained may be surprising even to the designers and builders, who believe that they know their product from start to finish. And because of some of these surprises and the facts brought out we may expect improvements in design and construction, as well as major strides forward in efficient operation and maximum production.

So let us hope that before long lathes, planers, millers, drilling machines and all the other standard machine tools will be completely time studied—and when such a machine is shipped new from the factory, may it be accompanied by a booklet giving in table form the results of the studies that have been made.

British Report on the Metric System

FOR some two years a British Committee on Commercial and Industrial Policy After the War has been at work on specific subjects that have been assigned to it among which was a proposal to adopt the metric system throughout the British Empire. This committee has now rendered a final report declaring that it cannot recommend the compulsory adoption of the metric system. The following are a few excerpts which indicate the character of the conclusions of the Committee:

> Having given very full consideration to the subject, we are unable to recommend the compulsory adoption of the metric system in this country.
>
> In our opinion, it is absolutely certain that the anticipated uniformity could not be obtained for a very long period, if ever.
>
> There is, further, the serious objection that if we induced the above mentioned counrties to change over to the metric system, we should be surrendering to Germany the advantage which our manufacturers now enpoy over hers, both in their markets and our own.
>
> We are informed that even in France, which has made the metric system nominally compulsory for more than a half a century, the "pouce" (or inch) is used in textile manufacture and numerous local measures still survive.
>
> In referring to these considerations, we have to point out that there is no unanimity even as to the theoretical merits of the metric system as compared with our own. The practical argument that its adoption is desirable in order to secure uniformity in the markets of the world has been shown to be unfounded. We are not satisfied by any evidence which has been brought before us that trade has actually been lost to this country owing to the fact that the use of the metric system is not compulsory.
>
> But to attempt to make the use of the system universal and obligatory in this country would cause great loss and confusion at a particularly inopportune moment for the sake of distant and doubtful advantages. We are convinced that, so far from assisting in the re-establishment of British trade after the war, such a measure would seriouly hamper it.
>
> As regards the educational advantages claimed for the change, we have been referred to a statement quoted by the Select Committee of 1895 that no less than one year's school time would be saved if the metric system were taught in the place of that now in use. The information which we have received does not support that statement, and even if it were well founded, it must be remembered that for at least a generation, children would have to learn both the new and the old measures and how to convert from one to the other.
>
> It is often popularly supposed that the introduction of the metric system would render possible the immediate sweeping away of many complicated and varying weights and measures. As we have already indicated, this belief is, in our opinion, wholly fallacious.
>
> We are not convinced that the metric system is, upon the whole, even theoretically superior to the British system, and we are satisfied that the practical objections to the proposed change are such as decisively to outweigh any advantages which are claimed for it.

A further point worthy of serious consideration in this British report deals with the matter of German propaganda. A recent report of the American Institute of Weights and Measures declares: "That those who work for the adoption of the metric system unwittingly and unconsciously work for Germany."

Enemy Property

WE are using two major means to make war on Germany and Austria. One is the force of American arms; the other is the power of our economic pressure.

Our efforts on the economic side of warfare bring to bear upon the enemy every force that we can muster to stop his supply of food, to prevent munitions and money from reaching him, and to improverish him and make him weak and impotent.

On the day that the United States of America entered the war there was in this country millions upon millions of dollars worth of property belonging to Germans and Austrians. This property was in mines, factories, banks, steamship lines, farms, plantations, and in fact all forms of our National wealth. Its total amount may run into billions of dollars. At the outset we had no means of estimating its amount, but up to the present time more than three-quarters of a billion dollars worth of this property have been reported to the Alien Property Custodian. Government investigations show that much more remains to be located. Hardly a day goes by without some statement passing through the press of the turning over to the Custodian of some great industry or some large block of property.

When war was declared the Army and Navy started to mobilize men and munitions. The Shipping Board began to build the fleet, the War Trade Board proceeded to cut all commercial relations with the enemy, and the Alien Property Custodian began to gather into the Treasury of the United States every penny of German and Austrian owned money that could be found.

But the duties of the Alien Property Custodian are not exactly what the name might seem to imply. In addition to the work of taking over and administering the property holdings of enemies, he has power given by Congress to sell outright most properties of the great industrial and corporation classes of Germany, wherever they may be located in the United States.

Every American citizen has a direct interest in all this work. It is a means for prosecuting the war. It is helping toward victory. Anyone who has any knowledge of enemy owned property should report the facts to the Bureau of Investigation, Alien Property Custodian, Washington, D. C.; but in order to give adequate help it is important to know just what is meant by "enemy property" and just who is the "enemy."

Enemy property includes any and every kind of property, money, chattels, securities, land, indebtedness, accounts receivable, etc., which belongs to an enemy. Even if the property is held in the name of another—as by a dummy or in trust—if the real beneficial interest belongs to an enemy, it is enemy property.

As defined by act of Congress, an enemy is:

> 1. Any person regardless of citizenship or place of birth, which is within the boundaries of Germany, Austria-Hungary, or their allies, or within the territory actually occupied by their military or naval forces. A peaceful and law-abiding German or Austrian citizen residing in the United States is not an enemy; but an American citizen living in enemy territory is an enemy.
>
> 2. A person residing outside of the United States and doing business within the territory of enemy countries or their allies.
>
> 3. A corporation, if incorporated within the territory of enemies or their allies, or incorporated in any neutral country and doing business within the territory of enemies or their allies.
>
> 4. An official or agent of an enemy Government or any subdivision thereof.

5. All natives, citizens, or subjects of Germany or Austria-Hungary interned by the War Department.

6. All citizens or subjects of Germany or Austria-Hungary resident outside of the United States who are (a) wives of officers, officials or agents of Germany or Austria-Hungary, wherever resident; (b) wives of persons within the territory (including that occupied by military and naval forces) of Germany or Austria-Hungary; or (c) wives of persons resident outside the United States and doing business within enemy territory.

7. Citizens or subjects of Germany or Austria-Hungary who are prisoners of war or who have been or shall be interned by any nation associated with the United States in the war.

8. Citizens or subjects of Germany or Austria-Hungary who since April 6, 1917, have disseminated or shall hereafter disseminate propaganda to aid any enemy nation or to injure the cause of the United States, or who have assisted, or who shall assist in plotting against the United States or any nation associated with the United States in the war.

9. Citizens or subjects of Germany or Austria-Hungary who, at any time since August 4, 1914, have been resident within enemy territory.

It is important to know that items 2, 6, 8 and 9 apply only to persons who are residents outside of the United States of America.

Each one of us should feel his personal responsibility in this matter and assist in carrying forward the war by helping the Alien Property Custodian to gather in every penny of enemy property in the United States.

A Possible Contribution to Belgium

THE will of civilization to bring a crushing defeat to the Central Powers will one of these days consummate the greatest victory of arms that the world has ever known. Then will begin the perhaps greater work of rehabilitation and restoration in those countries that have been ravaged by the Hun. Martyred Belgium will the arise from her ruins and once more become a great industrial factor in the world's production and trade, and likewise the devastated regions of France and Italy, Servia, Roumania and Russia, will enter that period of renaissance which will finally restore them to conditions of prosperity perhaps never before known.

Anyone who is seeking for the good that will follow this great war can imagine no other result than the complete restoration on a better and grander scale than before existed of all of the areas over which the contending armies have fought and sacrificed.

Whenever we pause to consider just a little as to what must come and will come with the winning of peace, our thoughts turn quickly to heroic Belgium— that little nation that gravely stood up against the German onslaught rather than sacrifice her honor and her soul. As the first victim of the Teuton's mad drive for world power, our sympathies turn to her perhaps first when matters of restoration are being considered, and every American hopes that his country will be able to play an important part in the work of rehabilitation and reconstruction. But how can that hope be realized? What does industrial America know and practice that may perhaps be of benefit in this great industrial task of once more placing a nation of 7,000,000 people on a producing basis? What experiences have we had that may point to ways and means to begin to solve this problem and to accomplish this task.

In searching for a possible answer to these questions we naturally turn to some of the great industrial achievements of the present day in the United States. One of them is the work of the Emergency Fleet Corporation. In some form or other, in greater or less degree, the directors of that corporation have had to deal with every kind of industrial problem. There has been the selection of yards, the design and erection of buildings, the selection of producing equipment, the providing of transportation facilities, the building of an operating organization, the employment of the working force, the housing of the families of the workers, and so on—the list might be extended indefinitely. There has also been a variety of product—steel vessels, wooden ships, composite ships, concrete experiments, power plants, interior fittings, and so on. A single achievement, the building of the Hog Island Yard, will perhaps some day outrank in the sweep of its conception and in the final excellence of its construction and value of its results our world-famed Panama Canal.

Can we perhaps find in our Emergency Fleet Corporation a model for a similar corporation to undertake the industrial reconstruction of Belgium? In some aspects the tasks are similar. In magnitude the Belgian task is greater and it is far more diversified.

Belgian officials assure us that the financial side of the work of reconstruction will present no difficulties. Belgium still has wealth and when the score has been cast up around the peace table the German wealth turned over to Belgium should be many times greater than all of the needs of the entire country as far as industry is concerned.

So, with this starting point it is not conceivable that the American business mechanism, such as is represented in our Emergency Fleet Corporation, might be employed to take over the planning and administrative work of rebuilding, re-equipping and putting on a production basis all of the industrial interests of Belgium.

If some plan like this could go into effect, Americans would be pleased indeed, and if American engineers and industrial executives could contribute in a helpful way from their experience, everyone would consider it a privilege to be of service.

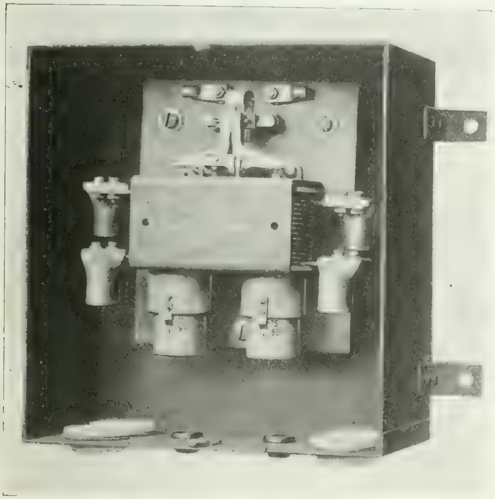
And, after all, is not this Belgium problem one that can only be solved by the industrial executive and the mechanical engineer?

Factory Equipment News

The Latest Labor-Saving Machinery

Safety First Relay

To provide means for supplying overload protection for alternating current equipment provided with starters or switches having low voltage protection, the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania, has just brought out a "safety first" relay. It is enclosed in a sheet steel case to exclude dust. The cover of this case is secured by two thumb screws, and is provided with a safety device which automatically trips the relay when the cover is removed, thus rendering all parts of the relay "dead" so long as the cover is off. The case is arranged for wall-mounting in any convenient place near the switching equipment. The relay operates by means of magnet coils that are inactive at loads less than that for which they are set. When a current reaches or exceeds this setting, the coils lift plungers which break the control circuit and operate the low-voltage relay to open the line circuit. With no current flowing in the line, the coils are de-energized and the relay is automatically reset, the bridge being pressed against the contacts by means of a compression spring.



WESTINGHOUSE SAFETY FIRST RELAY

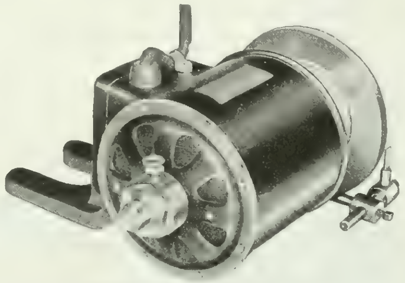
The plungers operate in oil dash-pots, providing a time element which allows the relay to carry a momentary overload without tripping. This time limit is adjustable by means of a small perforated disc in the dash-pot, which is accessible by unscrewing the dash-pot from the casting which holds it.

These relays are made for all commercial frequencies and voltages and in capacities of 5 to 100 amperes, which will operate over a wide range of current values, for which adjustments are made by lowering or raising the dash-pot. This is marked with a scale, and an indicator clearly shows the tripping value.

Electric Tool Post Grinder

An electric tool-post grinder driven by a ¼ horse power motor, running at a speed of 3,400 R.P.M. and built for two voltages, 110 to 220, is shown in the accompanying illustration. It is a product of the Gilfillan Bros. Smelting & Refining Company, Los Angeles, California.

The general design of the grinder is shown in the illustration. It is adapted to mounting a wheel 6 inches in diameter by ⅜ inch thick, and has an extension arbor for internal grinding adapted to carry a wheel 1½ inches in diameter by ⅜ inch thick.

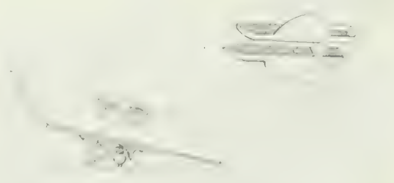


GILFILLAN ELECTRIC TOOL POST GRINDER

A tool rest is a part of the equipment for cutter grinding.

The Borst Fifth Wheel Trailer Control

THE accompanying illustration shows a fifth wheel with its controlling device for use with tractors and semi-trailers. It enables the driver, without moving from his position, to control the semi-trailer in backing into any position. A foot-pedal controls the action of both tractor and trailer making them move as a unit.



[illegible]

The fifth wheel platform or turn-table is constructed of steel plate permitting a sliding movement between tractor and trailer. The upper half of the fifth wheel coupler has two sliding bars rigidly attached to channel irons and supported on the bottom by a turn-table plate. These channel irons are long enough to make a bolster and can be attached easily to any trailer or wagon.

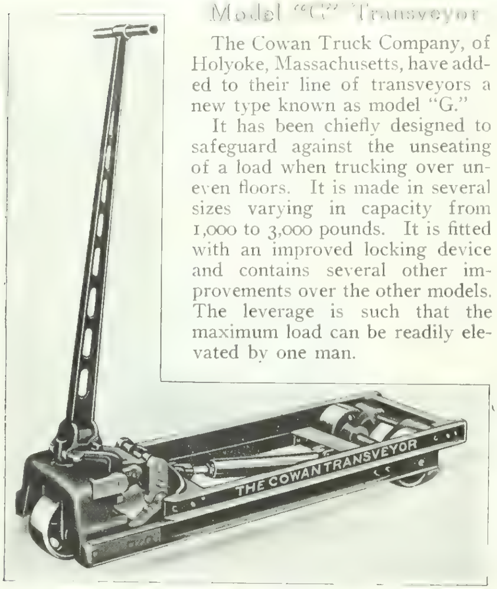
Supplied with the trailer control is a set of carrier jacks by means of which the trailer can be easily raised or lowered when tractor and trailer are being coupled together.

These devices are manufactured by the Borst Coupler Control Manufacturing Company, Buffalo, N. Y.

Model "G" Transveyor

The Cowan Truck Company, of Holyoke, Massachusetts, have added to their line of transveyors a new type known as model "G."

It has been chiefly designed to safeguard against the unseating of a load when trucking over uneven floors. It is made in several sizes varying in capacity from 1,000 to 3,000 pounds. It is fitted with an improved locking device and contains several other improvements over the other models. The leverage is such that the maximum load can be readily elevated by one man.



MODEL "G" TRANSVEYOR

Small Westinghouse Turbo Generator

THE accompanying illustration shows a new small turbo generator unit designed for 10 kilowatts output although a temporary load of approximately 12½ kilowatts may be obtained. A still smaller unit designed for 8½ kilowatts is suitable only for lighting work and electro magnet installations. It is built by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pennsylvania.

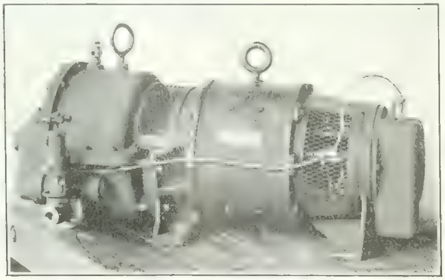


FIG. 1. 10 KW WESTINGHOUSE TURBO GENERATOR

In its construction the fact has been recognized that its field will be found in places where attendance and care might not be of the best. Thus it has been designed for trying conditions. At the same time it has many of the features of construction found in larger units. Among these is a hand and automatic throttle valve and an emergency over-speed governor. This latter device is on the generator end of the unit and automatically closes the throttle valve if there should be any tendency to overspeed.

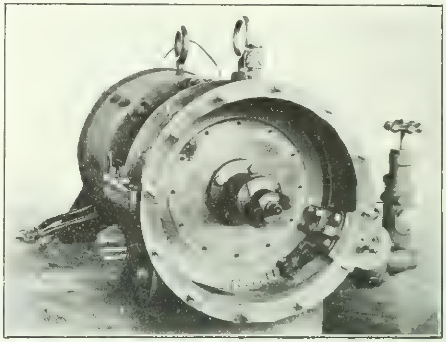


FIG. 2. COVER REMOVED FROM TURBINE

An important feature of this unit is the fact that it has but one revolving element, for the generator shaft is extended and also carries the turbine rotor. The rotor is made of high carbon open hearth steel forged to shape and accurately finished. The blades are of electric furnace steel held in place by pins driven through blade and rotor. The blades are of the impulse type and although there is only one row yet by means of a reversing chamber the same steam is passed through the blades a second time thus allowing expansion. The generator is equipped with ball-bearings. Figure 1 shows the ten kilowatt unit complete and Figure 2 shows the turbine end with the cover removed.

New Shepard Lathe

THE "New Shepard" line of screw cutting engine lathes manufactured by Shepard Lathe Company, Cincinnati, Ohio, has been increased by the addition of the 12-inch, all-geared head, semi-quick change type.

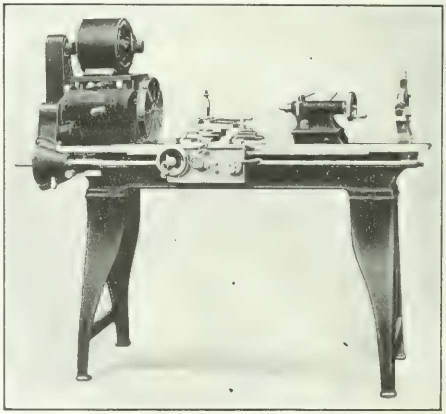


FIG. 1. THE NEW SHEPARD 12 INCH LATHE

This is equipped with several kinds of drives including the individual motor mounted either on the headstock or leg or a regular counter shaft or single pulley drive. Demonstrated features of construction used in other sizes of Shepard lathes have been included in this design. In the head stock is a reversing lever whereby the different feeds of the lathe may be instantly reversed without stopping the machine.

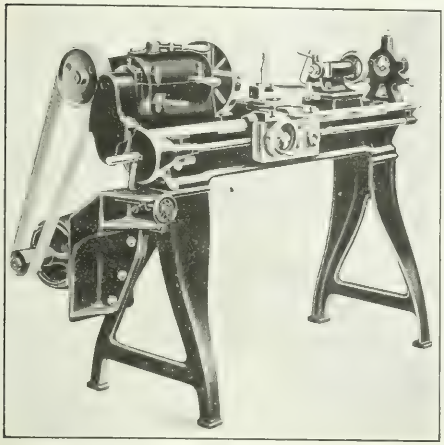


FIG. 2 SHEPARD'S SEMI-QUICK CHANGE LATHE

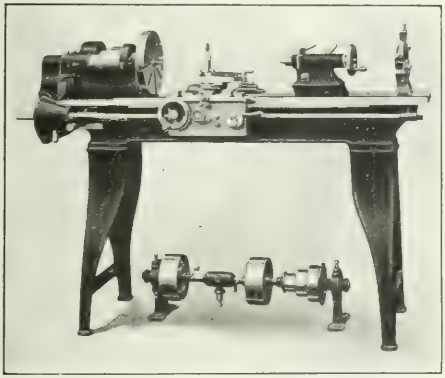


FIG. 3. SHEPARD LATHE WITH COUNTERSHAFT

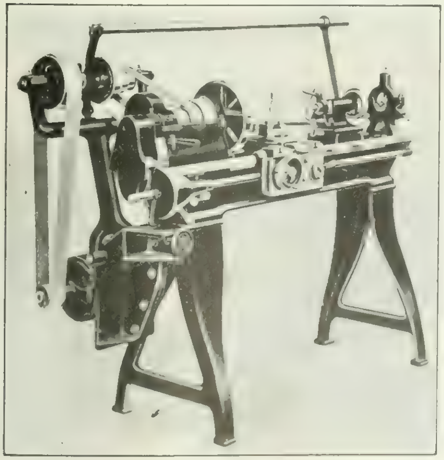


FIG 4. SEMI-QUICK CHANGE [illegible]

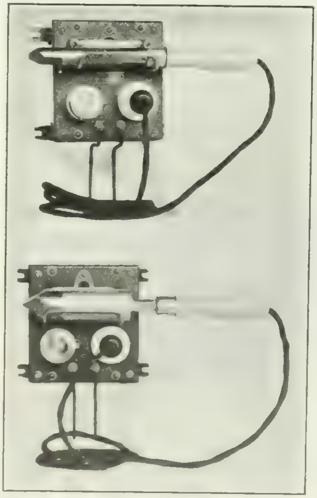
Six changes of spindle speeds are provided from 32 to 502 revolutions per minute. The drive is through a positive 7-jawed steel clutch. Changes in speeds and movements of the clutch are easily made by means of two conveniently situated levers. All clutches and small levers are of steel. The hollow spindle is turned from 50-point carbon steel, is ground to size and has a 1-inch hole permitting the use of draw in collets. The bearings are of phosphor bronze.

The carriage and combined rest are designed to give strength and rigidity. The combined rest is gibbed and graduated. The foot stock is of the off set type with a set-off for turning tapers.

Another addition to the "New Shepard" line is the 12-inch cone head, semi-quick change screw cutting lathes shown in Figures 3 and 4. Its characteristics are similar to the lathes already described. Figure 4 shows this machine equipped for individual motor drive where the motor is attached to a bracket bolted to the lathe log and a swinging arm is arranged to carry the drive cone. The counter shaft is controlled by means of a screw and hand wheel movement.

Rack for Electric Soldering Irons

AN automatically controlled, soldering-iron rack control panel, designed to decrease the amount of current required for heating irons and to prevent over heating and burnouts is shown in the accompanying illustration. It is a recent product of the Cutler-Hammer Manufacturing Company, Milwaukee, Wisconsin.

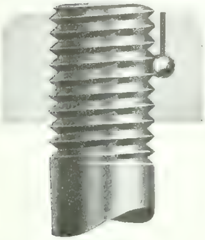


[illegible]

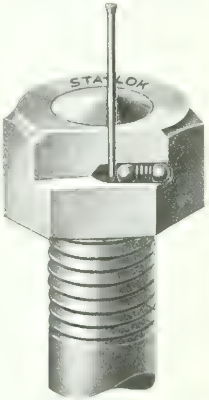
The rack consists of a small slate pannel arranged for wall mounting and carries a support for the iron which acts on the principle of the telephone receiver hook. When the iron rests on the support or hook it bears the support down and resistance which is mounted on the back of the panel is inserted in circuit with the iron. The current is thus reduced and the temperature held at a safe point. As soon as the iron is lifted from the hook the full current flows. Below the hook on the same panel there is a push button snap switch and a standard receptacle to which the plug of the soldering cord is connected. Thus this panel is in a way a soldering iron switch board for the switch can be snapped off at night completely opening the circuit to the soldering iron.

Sta-Lok Nut

THE two accompanying illustrations show the construction of a lock nut marketed under the trade name of a "sta-lok." The action of this nut is thus: After the nut is in place when effort is made to unscrew it a hardened steel ball which grips in a groove of the threads is held in contact by a spring and wedges into the thread, thus locking the nut. To remove the nut a nail is inserted as shown in one of the illustrations releasing the ball from the thread groove and permitting the nut to be backed off.



METHOD OF LOCKING

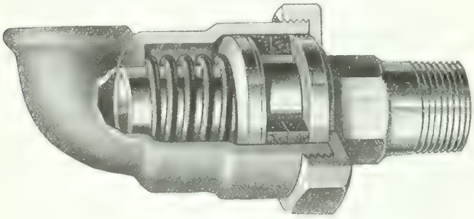


METHOD OF UNLOCKING

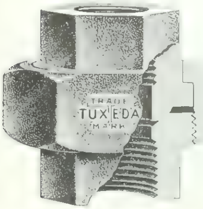
This lock nut is manufactured from bar screw stock with a special filleted top to give individuality. It is manufactured by the Evertite Nut Corporation, Detroit, Michigan.

Tuxeda Swing Joints and Unions

A SWING joint for use in lines conveying steam, oil, water, gas or air so constructed that the packing is held under a constant spring pressure as shown in the accompanying illustration. It is known as the Tuxeda swing joint and is manufactured by the Franklin Williams, Inc., 39 Cortlandt Street, New York, N. Y.



TUXEDA SWING JOINT ELBOW



TUXEDA UNION

The illustration shows the construction of the joint which depends for its tightness upon the ring of Tuxeda packing. To compensate for wear and keep the joint tight a helical spring keeps a constant pressure upon the packing.

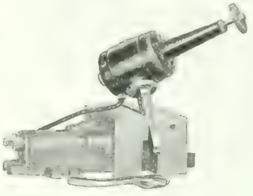
If necessary for any reason whatever the joint is easily taken to pieces and a new piece of ring packing inserted in a short time and with little trouble.

The internal construction for both the male end and elbow type of joint is standard. The design has been developed to allow sufficient play to compensate for irregularities of a regular run of pipe fittings.

Another Tuxeda product is a bronze union for high pressure steam. Both ends of the union are made hexagonal, thus affording a convenient grip with smooth faced wrenches.

Portable Electric Grinders and Drills

A SMALL, portable, electrically driven grinder, marketed under the trade name of "Dumore Junior Grinder," has recently been placed on the market by the Wisconsin Electric Company, Racine, Wisconsin. It is adapted for either external or internal grinding. The motor speed is 20,000 r.p.m., permitting the use of very small wheels, and the motor armature is dynamically balanced to eliminate vibration.



"DUMORE" ELECTRIC GRINDER

It is intended especially for use in small machine shops, tool-making shops, garages and the like, where a compact tool is needed and investment in a large grinder is unwarranted.

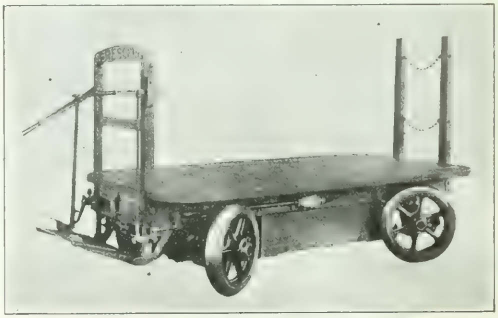
The "Dumore" electric drive drill shown herewith is an exceedingly compact and useful tool. The flexible conductor can be attached to an outlet on the bench and the motor can be started and stopped by the ordinary key switch provided on a receptacle.

The lever on the right side of the base is for holding the work up against the drill point.

PORTABLE ELECTRIC DRILL

Crescent Industrial Truck

THE accompanying illustration shows a four-wheel, all-wheel steer storage battery industrial truck



CRESCENT ALL-WHEEL STEER INDUSTRIAL TRUCK manufactured by the Crescent Truck Company, Elizabeth, New Jersey.

The frame is built up of four-inch channel irons, braced with gusset plates and cross members and riveted with ½-inch rivets. The platform is 23 inches above the floor and is constructed of 1½-inch planking and reinforced on the edge and corners with steel. Metal strips cross the platform and protect the flooring. The platform is hinged so that it can be raised and give easy access to the driving mechanism and battery.

The truck wheels are driven through a worm differential and a Timken worm and worm wheel mounted on S. K. F. ball bearings. The whole mechanism is enclosed and runs continually in oil. The wheels are of cast steel mounted on Timken roller bearings; the tires are of solid rubber, 20 inches in diamteer with a 3½-inch face. The truck is steered by a lever and is directly connected with all four wheels. This steering on all the wheels gives a turning radius of six feet, and permits the truck to enter the side door of a box car and run to either end. Provision is made to lubricate all knuckles and joints.

The motor takes 36 volts and 35 amperes at 1000 r.p.m. Under severe conditions it will take 120 amperes for 10 minutes without serious overheating. The controller is the drum type, with three speeds forward, three in reverse and a positive stop between. Several types of batteries can be supplied at the option of the user. This truck has a capacity of 4,000 pounds and speed per hour light of from eight to ten miles and loaded five to seven miles.

Personal and Business Items

Pipe Tool catalog No. 38 has been completely revised by the Greenfield Tap & Die Corporation of tribution in its new form. It shows the complete line of pipe tools manufactured by this firm.

* * * *

The Easton Car & Construction Company, Easton, Pennsylvania, announce the opening of a new branch office in Washington, D. C., the address being 225 Kellogg Building, 1422 F. Street, N. W.

* * * *

Mr. W. H. Callan, general manager of plants, and Mr. W. P. Pressinger, general manager of sales, have been elected vice presidents of the Chicago Pneumatic Tool Company, Chicago, Illinois.

* * * *

Mr. Willis B. Richards and Mr. Francis Oakey announce their association as public accountants and production engineers under the corporate name of Gunn, Richards & Company, 43 Wall Street. Mr. James Newton Gunn withdrawing.

* * * *

The Jeffrey Manufacturing Company, Columbus, Ohio, has recently issued catalog No. 231, showing the application of battery locomotives in industrial plants and similar places. It contains many illustrations and descriptions of various installments and gives information in regard to locomotive details.

* * * *

The Wellman-Seaver-Morgan Company, Cleveland, Ohio, has just issued bulletin No. 9, illustrating and describing freight car dumpers. The general arrangement of the towers and machinery is fully shown and a full page is devoted to views of unloading installations.

Mr. A. Heutter, has recently become Vice President and General Manager of the Premier Rubber & Insulation Company, Dayton, O., of which he is the founder. This firm completed its new plant April 1 of this year, and is now producing a line of hard rubber products largely for airplane and automobile use.

* * * *

The C. W. Hunt Company, Inc., West New Brighton, New York, announce the removal of their office from 45 Broadway, New York City, to the Astor Trust Building, 501 Fifth Avenue, New York. The reason for the transfer is found in the fact that the United States Government has taken over the entire building at 45 Broadway.

* * * *

The Nash Engineering Company of South Norwalk, Connecticut, has just issued bulletin No. 8 dealing with Jennings turbine vacuum and low pressure boiler feed pumps. The construction of the pump is fully illustrated and described, its method of installation is shown and general data are given in regard to sizes and capacities.

* * * *

Mr. W. A. Haines has been appointed district representative at Detroit of the Automobile Equipment Department of the Westinghouse Electric & Manufacturing Company. Among the automobile manufacturers of the Detroit district, Mr. Haines is favorably known through his service for some years as Assistant District Manager of that department of the Westinghouse Company.

* * * *

The Lakewood Engineering Company, Cleveland, Ohio, announce the publication of Bulletins No. 25 and 32. The first deals with Lakewood trackless haulage systems showing trucks, trailers and tractors for a wide variety of uses in handling materials around industrial plants and for construction work. Bulletin 32 is devoted to the Lakewood universal concrete mixer.

* * * *

Announcement is made that the business of the C. E. Knoeppel & Company has been incorporated under the firm name of C. E. Knoeppel & Company, Inc., without any change of business address. Mr. W. A. McCall and Mr. L. M. Brownell have severed their connection with the organization. Mr. Irving A. Berndt, formerly manager, betterment department of the Joseph T. Ryerson & Son, Chicago, has joined the new organization, in becoming vice president.

* * * *

The Foxboro Company, Foxboro, Massachusetts, announces the issuing of Bulletins 113 and 82-1. The first deals with orifice meters for measuring gas and shows the design, construction and application of these instruments. One page shows the factory radio planimeter used to determine average readings and static pressures from circular charts. Bulletin 82-1 is devoted to liquid level gages. Like the preceding bulletin it shows details of construction and installation with several pages given over to full size recording charts.

* * * *

Mr. Darton L. Babcock has joined the auditing department of the J. G. White Management Corporation, New York City. After spending several years in the service of banking institutions in Binghamton, N. Y. and New York City, Mr. Babcock entered the public utility field as an accountant. In 1915 he became connected with A. B. Leach & Company, New York City, being placed in complete charge of their accounting and financial routine. In 1916 he was appointed manager of the Cincinnati office of W. E. Hutton & Company.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears the price of the article is 20 cents. A denotes a price of 40 cents, B, 60 cents; C, 80 cents, D, $1.00, E, $1.20, F, $1.60. The letter N indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of INDUSTRIAL MANAGEMENT at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cents per month, or $3.00 a year.

REFERENCE LIST OF PUBLICATIONS REGULARLY REVIEWED AND INDEXED

ARRANGED IN ORDER OF THEIR ABBREVIATIONS

A A Wkly	Aerial Age Weekly
AERA	AERA
A I C E	Amer. Institute of Chemical Engineers
A I E E	Amer. Institute of Electrical Engineers
A I M E	Amer. Institute of Mining Engineers
A I Mt	Amer. Institute of Metals
Am Ec Rev	Amer Economic Review
Am El-Chem Soc	Amer Electro-Chemical Society
Am Fdymns Assn	Amer. Foundrymen's Association
Am Ir & Stl Inst	Amer. Iron & Steel Institute
Am Jl Pub Hlth	Amer. Journal of Public Health
Am Jl Sci	Amer. Journal of Science
Am Mach	Amer. Machinist
Am Ry Bdge & Bldg Assn	Amer. Railway Bridge & Building Association
Am Soc Ht & Vt Engrs	Amer. Society of Heat. & Vent. Engrs.
Am Soc Mar Dftn	Amer. Society of Marine Draftsmen
Am Soc Nav Engrs	Amer. Society of Naval Engineers
Am Soc Ref Engrs	Amer. Society of Refrig. Engineers
Am Soc Tes Mat	Amer. Society of Testing Materials
Am Wd Pres Assn	Amer. Wood Preserv. Association
Am Wr Wks Assn	Amer. Water Works Association
A R E A	Amer. Railway Engineering Association
A R M M A	Amer. Raliway Mas. Mech. Assn.
Arch For	Architectural Forum
Arch Rec	Architectural Record
A S C E	Amer. Society of Civil Engineers
A S M E	Amer. Society of Mechanical Engineers
Assn Eng Soc	Association of Engineering Societies
Assn I S E E	Association of Iron & Steel Elec. Engrs.
Aus Min Stan	Australian Mining Standard
Auto	Automobile
Autocar	Autocar
Beama Jl	Beama Journal
Bkn Engs Cb	Brooklyn Engineers' Club
Bos Soc C E	Boston Society of Civil Engineers
Br Rds & Sts	Better Roads and Streets
Brs Wld	Brass World
Bt Fc & Stl Pt	Blast Furnace & Steel Plant
Can Engr	Canadian Engineer
Can Fndman	Canadian Foundrymen
Can Min Inst	Canadian Mining Institute
Can Min Jl	Canadian Mining Journal
Can Soc C. E.	Canadian Society of Civil Engineers
Cas Eng Mthly	Cassier's Engineering Monthly
Cen Ry Cb	Central Railway Club
Chem & Met Eng	Chemical & Metallurgical Engineering
Chem & Met Soc S. A.	Chemical & Metallurgical So. of South Africa
Chem Eng & Min Rev	Chemical Engineering and Mining Review
Cl Age	Coal Age
Colly Gdn	Colliery Guardian
Col Sl Min Mag	Colorado School of Mines Magazine
Col Univ Qly	Columbia University Quarterly
Com Air Mag	Compressed Air Magazine
Com Vhle	Commercial Vehicle
Comwh Engr	Commonwealth Engineer
Corn C E	Cornell Civil Engineer
Cr Min West Aust	Chamber of Mines of West Australia
E Cb Balt	Engineers' Club of Baltimore
E Cb Phila	Engineers' Club of Philadelphia
E Cb St L	Engineers' Club of St. Louis
Econ Geol	Economic Geology
Eff Soc Jl	Efficiency Society Journal
Elec Jl	Electric Journal
Elec'n	Electrician
Elec Rev	Electrical Review
Elec Rev Chi	Electrical Review, Chicago
Elec Ry Jl	Electric Railway Journal
Elec Wld	Electrical World
Eng & Con	Engineering and Contracting
Eng & Min Jl	Engineering and Mining Journal
Eng Ed	Engineering Education
Eng News Rec	Engineering News-Record
Engng	Engineering
Engr	Engineer
Eng Rv	Engineering Review
Engrs Soc Penn	Engineers Society of Pennsylvania
Fkn Inst Jl	Franklin Institute Journal
Flying	Flying
Fndry	Foundry
Gen Elec Rev	General Electric Review
Ht & Vtg Mag	Heating and Ventilating Magazine
Ice & Refrig	Ice & Refrigeration
Ill Eng Soc	Illuminating Engineering Society
Imp Inst Bul	Bulletin of the Imperial Institute
Ind Man	Industrial Management
InstAut Engrs	Institute of Automobile Engineers
Inst Rad Engrs	Institute of Radio Engineers
Inst San Engrs	Institute of Sanitary Engineers
Instn C E	Institution of Civil Engineers

Instn E E	Institution of Electrical Engineers
Instn E & S Scot	Inst. of Engrs. & Snpbldrs. of Scot.
Instn Mun & Cnty Engrs	Inst. of Munic. & County Engrs.
Instn Mech Engrs	Institution of Mechanical Engineers
Inst Met	Journal of the Institute of Metals
Instn Min Engrs	Institution of Mining Engineers
Instn Min & Met	Institution of Mining & Metallurgy
Int Mar Eng	International Marine Engineering
Iron Age	Iron Age
Ir & Cl Trds Rev	Iron & Coal Trades Review
Jl Actcy	Journal of Accountancy
Jl Geol	Journal of Geology
Jl Ind & Eng Chem	Journal of Indust. & Eng. Chemistry
La Eng Soc	Louisiana Engineering Society
La Nat	La Nature
L S Min Inst	Lake Superior Mining Institute
Machy	Machinery
Manr Assn Engs	Manchester Assn. of Engineers
Mfrs Rec	Manufacturers' Record
Mar Eng & Nav Arch	Marine Engineer & Naval Architect
Mer Eng Can	Marine Engineering, Canada
Mar Rev	Marine Review
Mas Boil Mkrs Assn	Master Boiler Makers' Association
M C B A	Master Car Builders' Association
Mech Wld	Mechanical World
Min Mag	Mining Magazine
Min & Met Soc Am	Mining & Metallurgical Soc. of Amer.
Min & Sci Pr	Mining & Scientific Press
Mun Eng	Municipal Engineering
Mun Engrs Jl	Municipal Engineers' Journal
Mun Jl	Municipal Journal
Nat Assn Corp Schls	National Assn. of Corporation Schools
Nat Engr	National Engineer
Nat Lime Mfrs Assn	National Lime Manufacturers' Association
Nature	Nature
Naut Gaz	Nautical Gazette
N E C Instn	N-E Coast Institution
N E Rd Cb	New England Railroad Club
N E Wr Wks Assn	New England Water Works Assn.
N Y Dept Labor	New York State Dept. of Labor
N Y Rd Cb	New York Railroad Club
Per-Way Instn	Permanent-Way Institution
Phil Jl Sci	Philippine Journal of Science
Power	Power
Pr House	Power House
Pwr Pt Eng	Power Plant Engineering
Prof Mem	Professional Memoirs
Quarry	Quarry
Qnsd Gov Min Jl	Queensland Gov't Mining Journal
Roy Un Ser Instn	Royal United Service Institution
Ry Age	Railway Age
Ry Cb Pitts	Railway Club of Pittsburgh
Ry Engr	Railway Engineer
Ry & Loco Eng	Railway & Locomotive Engineering
Ry Mech Engr	Railway Mechanical Engineer
Ry Rev	Railway Review
Ry Sig Engr	Railway Signal Engineer
S A E	Society of Automobile Engineers
Schl Min Qly	School of Mines Quarterly
Sfty Eng	Safety Engineering
Sib Jl Eng	Sibley Journal of Engineering
So Af Inst Engrs	South African Instn. of Engineers
Soc Nav Arch & Mar Engr	Society of Naval Arch. & Mar. Engrs.
Soc Pro Sci Man	Soc. to Promote Sci. of Management
S & S W Ry Cb	Southern & Southwestern Railway Club
St L Ry Cb	St. Louis Railway Club
Stev Indic	Stevens Indicator
Tel Engr	Telephone Engineer
Telephony	Telephony
Times Eng Supp	Times Engineering Supplement
U S Bur Mines	U. S. Bureau of Mines
U S Bur Stds	U. S. Bureau of Standards
U S Dept Ag	U. S. Dept. of Agriculture
U S Geol Surv	U. S. Geological Survey
U S Nat Inst	U. S. Naval Institute
Weld Engr	Welding Engineer
West Eng	Western Engineering
West Ry Cb	Western Railway Club
West Scot I & S Inst	West. Scotland Iron & Steel Inst.
West Soc Engrs	Western Society of Engineers
Wis Engr	Wisconsin Engineer
Worc Poly Inst Jl	Worcester Polytechnic Inst. Journal

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. See the Explanatory Note given on the opposite page, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

Note.—The Index is conveniently classified into the larger division of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Air Pilots

See Mechanical Engineering, *Aeronautics.*

Americanization

Americanization a Problem in Human Engineering (86871). Henry D. Hammond. 3800 w. Eng News-Rec—June 13, 1918. Needs of foreign labor. Urgency of the situation.

What Is Americanization? (87166 A). 500 w. Ind Man—July, 1918. Editorial on opinions of Charles H. Paul as given in a report for The Solvay Process Co.

Ballistics

A Field Ballistic Problem (87185 B). 27 pp. U S Art, Jl—Jan.-April, 1918. Aims to give artillery officers a working knowledge of the ballistic problems they are apt to encounter.

Documentation

La Documentation Technique Et Industrielle (87140 B). General Sebert. 5600 w. Génie Civil—May 25, 1918. Serial, 1st part. General system of classifying and recording publications on technical and industrial topics.

Education Bill

Notes on the Education (Scotland) Bill (87085 N). William Jarvie, with short discussion. 3000 w. Instn Min Engrs, Trans—May, 1918. Details of the bill.

Engineers

An Address to Graduating Student Engineers (86757 A). E. W. Rice, Jr. 4500 w. Gen Elec Rev—June, 1918. Importance of engineers in times of peace and war and the education desirable to meet requirements.

The Engineering Profession Fifty Years Hence (86861 A). J. A. L. Waddell. 4800 w. Sci M—June, 1918. Serial, 1st part. Account of the organization of the American Academy of Engineers. its aims and work.

Examinations

Mine Managers' Examinations (87078 A). 1800 w. Colly Gdn—May 31, 1918. Serial, 1st part. Questions set for certificates of competency.

Military Training

Commercial Value of Military Training (87187 B). Lewis Sanders. 2500 w. U S Art, Jl—Jan.-April, 1918. The objects of military training and the results.

Mining Engineering

The Human Side of Mining Engineering (86955). James F. Kemp. 5000 w. Min & Sci Pr—June 15, 1918. Commencement address at Missouri School of Mines, on training for personal relations in conducting industrial enterprises.

Research

The Development of Technical Research (87112 A). 1000 w. Nature—May 16, 1918. General review of progress in technical research.

Topical Discussion on Coöperation in Industrial Research (86993 N). 32 pp. Am Soc Test Mat—June, 1918. Speakers are Dr. Henry M. Howe, Dr. John Johnston, Dr. Arthur D. Little, Dr. Charles L. Reese, and Mr. Frank E. Gorrell.

Schools

Vestibule Schools for the Unskilled (87080 A). H. J. Miles. 2200 w. Ind Man—July, 1918. Shows how such schools should be organized and gives results from those in operation.

Shipyard Workers

See Training, under Marine and Naval Engineering.

FINANCE AND COSTS

Accounting

Accounting for Liberty Loan Subscriptions (86908 A). Arthur F. Jones. 1000 w. Jl Actcy—June, 1918. The system used in Portland, Ore.

A Simple Cost Accounting System (86956). E. C. Constans. 3000 w. Telephony—June 8, 1918. Details of a system which has proved satisfactory in plant of 2000 subscribers with office force of three people.

A Simple Foundry Cost and Accounting System (86778). William W. Bird. 2000 w. Fndry—June, 1918. Method in Foundry Dept. of Worcester Polytechnic Institute.

Mechanical Devices for Disbursement Accounting (86850). 5000 w. Ry Age—June 14, 1918. Complete report of the committee on disbursement accounts of the Railway Accounting Officers.

Mechanical Accounting Devices for Railway Work (87171). Ills. 5000 w. Ry Rev—June 22, 1918. Abstract of report of committee of the Assn. of Ry. Acct. Officers, giving data on the use of mechanical devices in accounting work.

Business Principles

See same heading under Regulation.

Credit

Credit Expansion Under the Federal Reserve (86803 N). H. I. Reed. 12 pp. Am Ec Rev—June, 1918. Explains the present financial situation and the problem of gold-holdings of reserve banks.

Evaluation

The Most Economical Production Lot (86905 A). F. W. Taft. 1200 w. Iron Age—May 30, 1918. Formulas for exact and approximate evaluation.

Inflation

Inflation (86862 N). E. W. Kemmerer. 22 pp. Am Ec Rev—June, 1918. The extent of inflation since the war; the evils and benefits.

Manufacturing

Manufacturing in Relation to Banking, Research, and Management (86686 A). Walter Rautenstrauch. (Abstract.) 6000 w. A S M E, Jl—June, 1918. Economic problems and their solution or relief.

Price

Price Maintenance (86864 N). H. R. Tosdal. 22 pp. Am Ec Rev—June, 1918. Examines the interests of manufacturers and middlemen and the question of consumers' welfare.

Public Utilities

Effect of War Upon Public Utilities (87180). H. Wurdack. 3000 w. Elec Rev, Chi—June 22, 1918. Reviews serious difficulties due to increased costs.

Working Capital

Rational Basis for Determining Working Capital (86620). Gaskell S. Jacobs. 3500 w. Eng News-Rec—May 30, 1918. Analysis of maximum lag of collections behind disbursements.

MANAGEMENT

Efficiency

Profits of Efficiency (86866 N). C. J. Foreman. 18 pp. Am Ec Rev—June, 1918. Gives a method of separating the earned returns of efficiency from the unearned surpluses of the market and of good will.

Employment Managers

First Epoch of a New Profession (87163 A). Meyer Bloomfield. 1000 w. Ind Man—July, 1918. Reviews the work of the Employment Managers' Assn.

Foremen

What I Would Do If I were a Foreman (87162 A). Mark M. Jones. 4000 w. Ind Man—July, 1918. Attitude toward workmen and executives, etc.

Labor Economy

Labour Rations For Factories (87142). 2500 w. Times Engng Supp—May, 1918. Necessity of economizing man power.

Methods

Valuation of Power Plant Methods (87134 C). W. N. Polakov. 1400 w. Paper read before Tech. Assoc. Pulp & Paper Industry at Dayton, O., May 16, 1918. Paper, May 22, 1918.

Planning

Planning and Progressing (86859 B). John Halloway. 10 pp. Cas Eng Mthly—May, 1918. Methods, with examples.

Power

Mastering Power Production—VII (87087 A). Walter N. Polakov. Charts. 7000 w. Ind Man—July, 1918. Analysis of four methods used to pay additions to regular wages. Considers task work with bonus the only scientific way.

Shop Practice

See same heading under MECHANICAL ENGINEERING, *Machine Works and Foundries.*

Wages

A System of Labor Compensation (86966 A). M. K. Smogorjevsky. 4500 w. Ry Mech Engr—June, 1918. A combination of the Taylor, piecework, and Prusso-Hessian methods developed in Russian railway shops.

Co-operative Payment - by - Results (86720 A). 1500 w. Engr—May 17, 1918. A simple but ingenious system which has given satisfactory results.

Workmanship

Workmanship As An Efficiency Aim (87094 A). C. W. Starker. 2000 w. Ind Man—July, 1918. Efficiency methods often wrongly applied. Stimulate money making rather than pride in work.

REGULATION

After-the-War

Great Britain Working on After-the-War Problems (87014). Wingrove Bathon. 2500 w. Eng News-Rec—June 20, 1918. Work of the ministry of reconstruction and advisory council.

Barred Zone

Barred Industrial Zone in Eastern States (87007 A). Map. 1500 w. Iron Age—June 20, 1918. No new manufacturing plans to be built in it because of present congestion and impossibility of getting coal.

Business Principles

Evolutionary Business Principles (87088 A). L. P. Alford. 2500 w. Ind Man—July, 1918. Brief report of principles declared by H. L. Gantt and C. E. Knoeppel before the U. S. Federal Trade Commission.

Express Merger

Merger of Express Companies (86640). 3000 w. Ry Rev—June 1, 1918. An agreement by which the Adams, American, Wells Fargo, and Southern express companies have been merged into one corporation to be known as Federal Express Company.

Food Administration

Food for the War (86800). H. C. Hoover. 5500 w. West Eng—June, 1918. Address before the Pittsburgh Press Club on April 18. The need of coöperation between producers, manufacturers, distributors, and consumers of food.

Labor

Forbids Time Studies and All Bonuses (86843 A). 2500 w. Iron Age—June 13, 1918. House overrules its Committee on Military Affairs and votes for limitation of output.

The Efficient Utilization of Labor in Engineering Factories (With Special Reference to Women's Work) (86723 A). Ben H. Morgan. Read before Instn. of Mech. Engrs. (Abridged.) 4000 w. Engr—May 17, 1918. General considerations regarding the employment of women; standardization, etc.

The Problem of Labor Turnover (86865 N). Paul H. Douglas. 11 pp. Am Ec Rev—June, 1918. Examines its nature, extent, cost, and its causes and remedies.

Power

See same heading under Management.

Publicity

Pitiless Publicity in Business (87165 A). 700 w. Ind Man—July, 1918. Editorial on H. L. Gantt's testimony before the Federal Trade Commission advocating fullest publicity.

Public Utilities

See same heading under Finance and Costs.

Rate Setting

Time Studies for Rate Setting on Gisholt Boring Mills (87096 A). Dwight V. Merrick. Ills. 3000 w. Ind Man—July, 1918. Serial, 1st part. Preparation of a boring mill for work to be done, giving tabulated data.

Reconstruction

Readjustment and Reconstruction Commission (86635). Wingrove Bathon. 1600 w. Elec Wld—June 1, 1918. Serial, 1st part. Suggests the creation of an agency to deal with the inevitable after-war problems.

Sales Engineering

Ethics of Sales Engineering (87177). Walter G. Stephan. 2000 w. Power—June 25, 1918. Discusses the ethics of salesmanship from various viewpoints.

Specialization

Specialization in Industry (86717 A). 2500 w. Engr—May 10, 1918. The growth of this tendency in modern industry and its disadvantages, and possible remedies.

Taxes

The Income Tax (86804 A). Carl G. Barth. 5500 w. E Cb Phila, Jl—June, 1918. Serial, 1st part. An engineer's analysis with suggestions.

Automobile Tax Hearing Before the Ways and Means Committee (86890). 2500 w. Auto Ind—June 13, 1918. Congressmen favor higher tax. Statement made by Alfred Reeves before the ways and means committee.

Wages

McAdoo Puts Wage Increase Into Effect (86629). 3000 w. Ry Age—May 31, 1918. Increase of wages for railway employees by order of the director general.

Wage Increase for Railway Men (86963 A). Ills. 3000 w. Ry Mech Engr—June, 1918. A minimum hourly wage of fifty-five cents for mechanics allowed.

Women Workers

American Women in War Industry—II (87098 A). C. E. Kneoppel. 4500 w. Ind Man—July, 1918. Problems of living conditions, state laws, coöperation of labor agencies and the post bellum period.

Some Problems of Female Labor (86889). 2000 w. Auto Ind—June 13, 1918. Discusses kinds of work, wages, demands, etc.

Women's Place in the Electrical Industry (86785). Ills. 2000 w. Elec Wld—June 8, 1918. Their part in the production of electrical apparatus, and in central station work.

WELFARE AND SAFETY

Accidents

Industrial Accidents (87143). 1000 w. Times Engng Sup—May, 1918. Results of an investigation by Dr. H. M. Vernon of the causes of accidents in British munition works.

Benefit Association

The Employees' Benefit Association—VI (87090 A). W. L. Chandler. 4000 w. Ind Man—July, 1918. Final instalment of series deals with means of measuring results.

Camp Sanitation

Camp Sanitation in Trench Warfare (87186 B). 10 pp. U S Art Jl—Jan.-April, 1918. Details of methods adopted.

Employees

Central - Station Employee Relations (86786). Frank A. Farnsworth, Jr. Ills. 2500 w. Elec Wld—June 8, 1918. Benefits due to foresight in welfare work.

Fire Doors

Stopping Fires by Fire Doors (86858 A). C. E. Worthington. Ills. 2200 w. Sfty Eng—May, 1918. Reviews the history of their use.

Fire Protection

Fire Protection of Piers (86691 A). Frank V. Sackett. Ills. 5500 w. Int Mar Eng—June, 1918. Effectual methods of overcoming fire hazards on steamship piers.

La Prevenzione Incendi Negli Stabilimenti Industriali (87103 B). A. Ratti. 5500 w. Monitore Tecnico—Feb. 30, 1918. Serial, 1st parts. Methods of avoiding fire risks to persons and property in the city of Milan.

Some Economic Aspects of Fire Protection Problems and Hazards in War Time (86683 A). J. Donald Pryor and Frank V. Sackett. (Abstract.) Ills. 8500 w. A S M E Jl—June, 1918. Outlines the broader principles of fire-protection in essential industries.

Hospital Protection

How Army Hospitals Are Being Protected Against Fire (86624). Ills. 1700 w. Eng News-Rec—May 30, 1918. Steps to improve fire resistance of wood-frame buildings.

Industrial Diseases

Siliceous Dust in Relation to Pulmonary Disease Among Miners in the Joplin District, Missouri (86931 A). Edwin Higgins, A. J. Lanza, F. B. Laney, and George R. Rice. Ills. 108 pp. U S Bur Mines—Bul. 132. Investigations, etc.

Physical Training

How Physicial Training Helps Factory Executives (87092 A). D. C. Stanbrough. 1200 w. Ind Man—July, 1918. Experience of the Packard Motor Co.

Rest Rooms

Rest Rooms and Their Influence on Application to Work (87164 A). L. H. Butler. Ills. 700 w. Ind Man—July, 1918. Benefits when properly managed.

Safety Code

Scope and Application of the National Electrical Safety Code (87158 A). 80 pp. U S Bur Stds, Circ. 72—June 17, 1918. Explains the need of the code and gives examples of electrical injuries which might be avoided by its application.

Safety Devices

Mine Safety Devices Developed by the United States Bureau of Mines (86817 N). Van H. Manning. 7 plates. 5000 w. Gov Print Office—Pub. 2473. Outlines the character and method of use of the more important devices.

Welfare Work

Reo's Clubhouse for Workers (86892). C. J. Shower. Ills. 1500 w. Auto Ind—June 13, 1918. Welfare work of the Reo Motor Car Co., Lansing, Mich.

MISCELLANY

Distribution

The Overseas Distribution of Engineering Appliances (86726 A). Leonard Andrews. Abstract of paper read before the Instn. of Elec. Engrs. 4500 w. Ir & Cl Trds Rev—April 19, 1918. How to obtain maximum efficiency in overseas trade and the costs to producers and the community.

Engineers

The Engineer After the War (86902 A). Bruce C. Yates. 4500 w. Pahasapa Qr—June, 1918. Address to the Dakota School of Mines.

Trade

Post-War Trade Policy (86705 A). 4000 w. Colly Gdn—May 3, 1918. Information from the reports of the English committee on commercial and industrial policy after the war.

War Needs

What We Must Do to Win the War (86758 A). E. W. Rice, Jr. Delivered before Pittsfield Section of A. I. E. E. 3500 w. Gen Elec Rev—June, 1918. Explains the need of every man, woman and child doing their utmost to assist war efforts.

Wars

Blocking New Wars (87021). Herbert S. Houston. 2000 w. Pwr Pt Eng—June 15, 1918. The force to do it. A league of nations.

Wool Industry

The Australian Wool Industry (86823 A). Ills. 1800 w. Aust Min Std—May 9, 1918. Serial, 1st part. Its possibilities and difficulties. What Australia is doing with the wool clip.

MECHANICAL ENGINEERING

AERONAUTICS

Aeronautical Problems

Aeronautical Problems Elucidated by Lessons from Paradoxical Windwheels (86879 A). Thomas O. Perry, with note by W. F. Gerhardt. 12 pp. Mich Tech—May, 1918. Experiments described.

Air Pilots

Scientific Tests For The Selection Of Pilots For The Air Force (87113 A). M. Flack. 1100 w. Nature—May 23, 1918. Outline of usual requirements and means of meeting them.

Airplanes

Airplanes of To-day (87047). Fay Leone Faurote. 3500 w. Auto Ind—June 20, 1918. Reviews the history of heavier-than-air machines.

Quantity Versus Quality in Airplane Combat (87052). J. G. Coffin and H. T. Booth. 2000 w. Auto Ind—June 20. 1918. Numerical superiority the controlling factor even when superiority of quality is on the other side.

The Austrian Berg Single-Seater Fighter (87071). Ills. 1000 w. A A Wkly—June 24, 1918. Detailed design.

Air Propellers

Air Propeller Performance and Design by the Specific-Speed Method (86929 F). M. C. Stuart. 18 pp. Am Soc Nav Engrs, Jl—May, 1918. New method of treatment of the performance and design of geometrically similar air propellers.

Biplanes

The Fredrichshafen Bombing Biplane (86766). Ills. 3000 w. A A Wkly—June 10, 1918. Serial, 1st part. A report issued by the technical department of the Department of Aircraft Production, British Ministry of Munitions.

The Lawson M. T. 2 Tractor Biplane (86647). Ills. 1200 w. A A Wkly—June 3, 1918. Characteristics and recent improvements.

The Spad Two-Seater Biplane (87053). Ills. 1200 w. Auto Ind—June 20, 1918. Strut arrangement different from single-seater; dual control, etc.

Classification

System of Classification for Aeronautical Information (87055). Fay L. Faurote. Ills. 3000 w. Auto Ind—June 20, 1918. Simple arrangement for filing data for quick reference.

Engines

The Mercedes 240 H. P. and 180 H. P. Aero Engines (86834 A). Ills. 1000 w. Engr—May 24, 1918. Serial, 1st part. Describes interesting features.

The Renault 400 Hp. Aircraft Engine (86735). Ills. 1500 w. Auto Ind—June 6, 1918. Used for bombing and combat planes.

The 240 H. P. (8 Cylinder) Mercedes (87072). Ills. 1200 w. A A Wkly—June 24, 1918. Detailed report on the design based on an investigation of the engine taken from the German two-seater Albatross Biplane, brought down in May, 1917.

Flying

Acrobatic Flying (87074). Charles W. Keene. Ills. 1000 w. A A Wkly—June 24, 1918. Describes loops, tailspins, upside down glide, reverse loop, and other feats.

German Planes

Évolution De L'Aviation Allemande (87125 B). J. A. Lefranc. Ills. 2700 w. La Nature—May 11, 1918. Third article on development of German aviation. Details of bombing equipment and electric circuits for fighting planes. Arrangement of guns, etc.

Guynemer

Captain Georges Guynemer, France's Greatest Ace (86596). W. F. Bradley. Ills. 3500 w. Auto Ind—May 30, 1918. Serial, 1st part. Life story of an aviator who had accounted for more than 100 enemy fliers

Hydro-Aeroplanes

Il Problema Degli Idrovolanti (87102 C + D). A. Guidoni. Ills. 2000 w. Rivista Marittima—Mar., 1918. Recent examples of Italian and other hydro-aeroplanes. Motors, speed, manoeuvering flight and other characteristics.

Problems

Present-Day Problems in Aeronautics (87046). W. B. Stout. Ills. 6000 w. Auto Ind—June 20, 1918. How can we secure the advantages which the monoplane offers, reduce the resistance of the biplane, and obtain greater aerodynamic ability in the airplane?

Sea Flying

Flying Boat and Hydroaeroplane for Sea Flying (86692 A). Giuseppi Adamoli. Ills. 3000 w. Flying—June, 1918. Limitations of the double float seaplane for rough water landing; training flying; boat pilots; starting; landing, etc.

Steel Tubing

Steel Tubes, Tube Manipulation, and Tubular Structures for Aircraft (87073). W. W. Hackett and A. G. Hackett. 4000 w. A A Wkly—June 24, 1918. Reviews methods of manufacture, some of the difficulties, tests, etc.

Seamless Steel Tubing (87157). 1000 w. Times Engng Supp—May, 1918. Abstract of paper by W. W. and A. G. Hackett before Aeronautical Society, England.

Triplanes

The Fokker Triplane (86718 A). 1000 w. Engr—May 10, 1918. Considers it one of the poorest of modern German designs.

AUTOMOBILES

Bodies

Quantity Production of Sheet Metal Bodies (87048). J. Edward Schipper. Ills. 2200 w. Auto Ind—June 20, 1918. Serial, 1st part. Methods used.

Development

Pioneer Automobile Development (86588 B). Prescott Warren. 3000 w. S A E, Jl—May, 1918. Reviews the history and states the attributes of the ideal car.

Differentials

Positive Pull Differentials (87050). A. C. Woodbury. Ills. 4500 w. Auto Ind—June 20, 1918. Various types and their action in turning corners and when one wheel loses traction.

To avoid error, please order by title and number only.

Engines

Templar Four Employs Improved Overhead Valve Construction (86598). Ills. 1000 w. Auto Ind—May 30, 1918. Small-bore, high-speed engine used on 118-in. wheelbase chassis.

Test Results of the Hvid Engine (87054). 1500 w. Auto Ind—June 20. 1918. Tests made at Armour Inst. of Technology under direction of Daniel Roesch.

Liquid Fuels

Liquid Fuel from Cannel Coal (86824 A). W. R. Ormandy. Ills. 1000 w. Autocar—May 25, 1918. A consideration of the possibilities and a comparison of cannel with other coals.

Lubrication

Lubrication of Tractor Engines (86592 B). W. G. Clark, with discussion. 8000 w. S A E, Jl—May, 1918. Types of oiling systems: selection and tests of lubricants.

Magnetos

Electrical Performance of the Transforming Magneto-Generator (87049). Harry F. Geist. Ills. 3000 w. Auto Ind June 20, 1918. Explains what takes place electrically in a self-contained high tension magneto.

Motor Sweepers

City of Buffalo Finds Motor Sweepers More Efficient Than Horses (86648 A). George W. Grupp. Ills. 1500 w. Com Vhle—June 1, 1918. Advantages.

Pistons

Aluminum Piston Development (86893). J. Edward Schipper. Ills. 2200 w. Auto Ind—June 13, 1918. Reduced expansion sought in new mixtures with closer grain.

Steam Cars

Electrically-Controlled Steam Automobiles (86589 B). Abner Doble. Ills. 6500 w. S A E, Jl—May, 1918. Development of steam cars; steam generators; ignition system; engines; lubrication, etc.

Discussion on Steam Automobiles at Metropolitan Section Meeting (86591 B). 6500 w. S A E, Jl—May, 1918.

The Case of the Steam Car (86590 B). John Sturgess. Ills. 5000 w. S A E, Jl—May, 1918. Relates particularly to the Stanley car; why they are built, etc.

Tractors

Emerson-Brantingham Model A A Tractor (86891). P. M. Heldt. Ills 2800 w. Auto Ind—June 13, 1918. A three to four-plow machine with inclosed internal-gear drive and an interesting combination of transmission and rear axle.

Moline Universal Model D Tractor (86736). P. M. Heldt. Ills. 2500 w. Auto Ind—June 6, 1918. Four-cylinder valve-in-head engine substituted for two-cylinder opposed.

R. & P. Tractor Has Enclosed Drive (86597). Ills. 1000 w. Auto Ind—May 30, 1918. Automobile type chassis employed with unit power-plant, transmitting drive through double reduction internal gear rear axle.

Transmissions

Hydraulic Power Transmission (86593 B). F. McDonough, with discussion. Ills. 3500 w. S A E, Jl—May, 1918. Explanatory, stating merits.

Tractor Transmission Design (87051). N. B. Nelson. 1500 w. Auto Ind June 20, 1918. Materials, types of shaft fittings and bearings to use.

Trucking

Trucks on Concrete Roadways Distribute Supplies at Railway Shops (86619) Con. M. Buck. Ills. 1500 w. Eng News-Rec—May 30, 1918. Methods of Santa Fe in handling stores at Topeka shops.

Hauling Eggs by Truck (86649 A). 1800 w. Com Vhle—June 1, 1918. Haulage from Vineland, N. J., to New York City.

Truck Operation

The Advantages of a Standard System for Recording Truck Operating Costs (87045). S. V. Norton. 1500 w. Eng & Con—June 19, 1918. Abstract of a recent article on features of a standard system.

Truck Repairs

Great Baltimore Quartermaster Depot Repairs Trucks on Standardized Plan (86919 A). Ills. 1000 w. Com Vhle—June 15, 1918. Constructed for training men in maintenance work. Every repair done by manual.

COMBUSTION MOTORS

Engines

High Speed Internal Combustion Engines (86698 N). Harry R. Ricardo. Ills. 44 pp. N E C Instn—April 30, 1918. Features of high-speed engine design and points on which designers have concentrated attention.

Oil Engines (87020). Ills. 1400 w. Pwr Pt Eng—June 15, 1918. Serial, 1st part. Principles of operation, characteristics and efficiencies.

The Heavy Oil Engine (86803 A). Charles E. Lucke. 12000 w. E Cb Phila, Jl—June, 1918. Development to the present time and reasons for believing a change is about to take place.

Internal Combustion Engine Design (86714 A). Jas. Dunlap. 1500 w. Mech Wld—May 10, 1918. Method of estimating or calculating quantities, thus eliminating guesswork.

Gas Engines

Augustine Rotary Two-Cycle Super-Induction Gas Engine (86796). Ills. 2500 w. Power—June 11, 1918. Detailed description of this new design.

Large Three-Crank Double-Acting Gas Engine (86835 A). Ills. 1000 w. Engr—May 24, 1918. Largest engine of its type yet constructed; built by the British Westinghouse Co.

Lubrication

Internal-Combustion Engine: Lubrication and Lubricants (86998 N). P. H. Conradson. 5 pp. Am Soc Test Mat—June, 1918. Essential factors to be considered in the selection of lubricants, and method of applying.

Waste Heat

Saving Waste Heat from Gas and Oil Engines (86652). Charles L. Hubbard. Ills. 2500 w. Pwr Pt Eng—June 1, 1918. Methods of utilizing gases to heat water in radiators, heaters and boilers.

HEATING AND COOLING

Air Conditioning

Dry Air and Cold Steam (86654). Frank Richards. 1000 w. Pwr Pt Eng—June 1, 1918. Relation of vapor and air in saturated mixture to temperatures and pressure

Central Heating

Inside Data on Central Station Heating (87029) W. H. Frehsee. 3000 w. Heat & Vent Mag—June, 1918. Practical points covering heating mains, fittings, street steam traps, service connections, etc

Cold Storage

Simple Design Marks Cold Storage Building for Apples (87013). Stewart T. Smith. Ills. 1200 w. Eng News-Rec—June 20, 1918 Reinforced-concrete frame and flat-slab floors with hollow tile walls separated by cork insulation.

Cold Storage In London (87156). 1400 w. Times Engng Supp—May, 1918. Warehouse recently built in London. Details of construction and of refrigerating plant.

Heat Insulation

Evolution of Heat Insulation (86651). Austen Bolam. 2000 w. Pwr Pt Eng—June 1, 1918. Materials tried, combinations, test results, and present practice.

Heat Transmission

Some Recent Studies in Heat Transmission (86815 B). Arthur J. Wood and Roy B. Fehr, with discussion. Ills. 40 pp. A S R E Jl—March, 1918. Studies aiming to establish constants applicable to practical engineering problems.

Hot-Water Heating

Hot-Water Service (87019). M. W. Ehrlich. Ills. 2200 w. Pwr Pt Eng—June 15, 1918. Method of calculating the required heating surface.

Refrigeration

Gas Formation in Ammonia Absorption Refrigerating Machines, Its Causes and Remedy (86814 B). E. C. McKelvy and A. Isaacs, with discussion. Ills. 17 pp. A S R E Jl—March, 1918. Experimental work and results

Horsepower Per Ton of Refrigeration (86961 A). Eric H. Peterson. 700 w. Ice & Refrig—June, 1918. Considers the compressor horsepower and the motor horsepower.

Purging Ammonia Condensers (86672). Thomas G. Thurston. Ills. 3500 w. Natl Engr—June, 1918 How to purge the air with a minimum loss of ammonia.

Tunnels

Ventilating the Big Highway Tunnel (87623). Ills. 1800 w. Com Air—June, 1918. Considers this problem in connection with the proposed highway tunnel under the Hudson river from Jersey City to New York.

Ventilation of Subways and Tunnels (86614). From *La Genie Civil*. 1200 w. Eng & Con—May 29, 1918. Deals especially with metropolitan subways.

Underground

Problems in Underground Pipe Construction (87030). Ills. 600 w. Heat & Vent Mag—June, 1918. Study of contrasts between work in medium-sized cities and in downtown district of New York.

MACHINE ELEMENTS AND DESIGN

Gages

Example of Precision Gage Making (86662 A). Ills. 1000 w. Machy—June, 1918. Methods of making and testing a gage requiring unusual accuracy.

Indicator Gages Used in Gasoline-Engine Construction (86666 A). C. C. Marsh. Ills. 4000 w. Machy—June, 1918. Gages for inspecting cylinder depth, length, external diameter, cam lift, profile, and eccentricity.

MACHINE WORKS AND FOUNDRIES

Boxing Machinery

Boxing Machinery to Prevent Damage (87095 A). Luther D. Burlingame. Ills. 4000 w. Ind Man—July, 1918. Practice of the Brown & Sharpe Mfg. Co. in packing machinery and tools for shipment.

Brass

Present Status of Brass Melting (86636). H. M. St. John. 3000 w. Elec Wld—June 1, 1918. Serial, 1st part. Fundamental principles of electric melting. Merits of different types of furnaces.

Castings

Casting a Slide Valve Locomotive Cylinder (86782). R. H. Palmer. Ills. 1200 w. Fndry—June, 1918. Details of operations involved in setting the cores.

How Crankcases for Sub-Chaser Engines Are Molded and Cast (86775). H. Cole Estep. Ills. 1500 w. Fndry—June, 1918. At a foundry in Muskegon, Mich.

Chains

Cast Steel Anchor Chain (87034 N). H. Jasper Cox, with discussions by W. L. Merrill and Chester K. Brooks. Ills. 45 pp. Am Soc Test Mat—June, 1918. Importance of reliability; essential qualities; experiments, specifications, etc.

Core Drying

Gas Fired Ovens for Baking and Drying Cores (86776). Bruno Rahn. Ills. 1200 w. Fndry—June, 1918. Installations required for varying oven types.

Die-Casting

Die-Casting of Aluminum Bronze Investigated (86781). H. Rix and H. Whitaker. Ills. 2500 w. Fndry—June, 1918. Aluminum alloys discussed and material for the dies described.

Drilling

Intensive Production — On Drilling Machines (86667 A). Edward K. Hammond. Ills. 4500 w. Machy—June, 1918. Organization of drilling department, and use of special equipment on machines to adapt them for a wide range.

Finishes

Black and Steel Gray Finishes on Brass and Iron (87028). Fred J. Liscomb. 4500 w. Brs Wld—June, 1918. Considers finishes and methods.

Foundry Practice

The Foundry Set Gate (86830 A). R. R. Clarke. 2200 w. Mech Wld—May 24, 1918. Its usefulness and methods.

Foundries

Gray Iron Foundry Designed to Save Manpower (86779). Ills. 4500 w. Fndry—June, 1918. New plant at Muskegon, Mich.

The New Lakey Foundry at Muskegon (86731 A). Harry C. Spillman. Ills. 1500 w. Iron Age—June 6, 1918. Details of a plant designed to take advantage of conditions of site.

Foundry Methods

The Stripping Plate Machine: Inception and Development (86894). Ills. 1200 w. Can Fndman—June, 1918. Serial, 1st part. Details of machines and work.

Reasoning Applied to Foundry Work—Its Rewards (86780). R. R. Clarke. 4500 w. Fndry—June, 1918. The value of brain power in solving foundry problems.

Furnace

A Rocking Electric Brass Furnace (86656 A). H. W. Gillett and A. E. Rhoads. Ills. 7000 w. Met & Chem Eng—June 1, 1918. A new type of arc furnace developed by metallurgists of the U. S. Bureau of Mines.

Lathes

Operating the Gridley Automatic Turret Lathe (86669 A). Douglas T. Hamilton. Ills. 3500 w. Machy—June, 1918. Serial, 1st part. Instructions for tooling and operating.

Machine Tools

Machine Tool Requirements of the Ordnance Department (86670 A). Abstract of an address by H. W. Reed, at Atlantic City. 2000 w. Machy—June, 1918. Outline of the large machine tools needed by the government.

Molding Machines

Foundry Moulding Machines (87147). 1500 w. Times Engng Supp—May, 1918. Serial, 1st part. Patterns and tables.

Munitions

Expenditure on Munitions (86724 A). 5000 w. Ir & Cl Trds Rev—April 19, 1918. Abstracts from report of the Comptroller and Auditor-General.

Routing and Handling Shells (86668 A). James Forrest. Ills. 3000 w. Machy—June, 1918. Production methods and short cuts for getting out large shells.

Les Obus Shrapnels (87130 B). H. Volta. Ills. 2300 w. La Nature—May 25, 1918. Shrapnel shells; their manufacture and characteristics.

Sidelights on Winchester Gun Production (86840 A). W. E. Freeland. Ills. 4000 w. Iron Age—June 13, 1918. Control of tools and gages; time study methods and satisfactory results.

Ordnance

How Ordnance Production Has Gone Forward (86732 A). 3000 w. Iron Age—June 6, 1918. Last year's contracts. Changes in organization.

Patterns

Pattern Making: Economical and Efficient Methods (86895). M. H. Potter. 1600 w. Can Fndman—June, 1918.

Pipe Bending

Bending Racks and Roll Benders for Large Conduit and Pipe (87181). Terrell Croft. Ills. 1000 w. Elec Rev, Chi—June 22, 1918. Serial, 1st part. Types of bending outfits.

Puddling

A Summary of Attempted Improvements in the Puddling Process (86812 N). Cecil H. Desch. Ills. 32 pp. West Scot I & S Inst, Jl—Jan.-Feb., 1918. Improvements aimed at; experiments, furnaces, etc.

Shop Practice

Managing Non-Repetitive Work (87161 A). Norman Howard. 3500 w. Ind Man—July, 1918. How to standardize conditions and operations for tool-making and machine-shop repairs.

Steel Tubing

See same heading under Aeronautics.

Tools

The Manufacture of High-Speed Tools (86860 B). Ills. 10 pp. Cas Eng Mthly—May, 1918. Serial, 1st part. Articles on British Key industries, dealing with the technical aspect and also with the organization.

Welding

Mechanically Operated Cutting and Welding Torches (86661 A). Edward K. Hammond. Ills. 5000 w. Machy—June, 1918. Explains methods of using and their applications.

Recent Progress in Electric Welding (86741). T. G. McKay, with discussion. Ills. 5000 w. Naut Gaz—June 8, 1918. Read before the Liverpool Eng. Soc. Advantages of recent methods.

Work-Benches

Design and Construction of Work-Benches (86663 A). Frank H. Mayoh. Ills. 3000 w. Machy—June, 1918. Bench legs and tops; portable work-benches.

MATERIALS OF CONSTRUCTION

Aeroplane Timber

Advance Rot and Latent Defects in Aeroplane Timber (86920). J. S. Boyce. 3000 w. [illegible] 1918. Discusses types of wood destroying fungi and defects an inspector must recognize.

Asbestos

L'Amiante Et Ses Applications Modernes (87131 B). A. Renouard. Ills. 3200 w. La Nature—May 25, 1918. Asbestos and its present day uses, sources of supply, etc.

Boiler Plates

On Certain Failures of Steel Boiler Plates Under Pressure (86811 N). Sidney A. Houghton, with discussion and correspondence. Ills. 38 pp. West Scot I & S Inst, Jl—Jan.-Feb., 1918. Failures are described and discussed.

Brass

Topical Discussion on Season and Corrosion Cracking of Brass (86997 N). Ills. 25 pp. Am Soc Test Mat—June, 1918. Speakers are William Campbell, W. H. Bassett, W. Reuben Webster, W. R. Woodward, and W. B. Price.

Cement

Silica Cement (87002 N). Robert J. Montgomery. Ills. 12 pp. Am Soc Test Mat—June, 1918. Covers in a general way the subjects of composition and testing.

Coatings

Report of Committee D-1 on Preservative Coatings for Structural Materials (86994 N). Ills. 27 pp. Am Soc Test Mat—June, 1918. Reports and recommendations.

Fireproofing

Report of Committee C-5 on Fireproofing (87004 N). 7 pp. Am Soc Test Mat—June, 1918. Proposed standard specifications for fire tests of materials and construction.

Hoisting Ropes

Length of Service and Care of Hoisting Ropes (86645). 2200 w. Eng & Min Jl—June 1, 1918. Proper modulus of elasticity for wire ropes is discussed and comparisons made of ropes of various constructions.

Lubricants

Report of Committee D-2 on Lubricants (86985 N). 5 pp. Am Soc Test Mat—June, 1918. Recommendations.

Keeping Power Plant Oil in Good Condition (86882). Harley Lett Smith. 2500 w. Elec Ry Jl—June 15, 1918. Discussion of care of oil in steam turbine power stations.

Non-Ferrous Metals

Report of Committee B-2 on Non-Ferrous Metals and Alloys (86995 N). 63 pp. Am Soc Test Mat—June, 1918. Proposed specifications and methods.

Paper

Une Culture Intensive De Pâte A Papier (87129 B). L. De Launay. Ills. 2700 w. La Nature—May 18, 1918. A new source of paper pulp from eucalyptus plantations in Spain.

Refractories

Refractory Materials Used in Casting Plants (86777). H. C. Arnold. 4000 w. Fndry—June, 1918. Serial, 1st part. Application of acid, basic, and neutral refractories, and tests for silica brick.

Refractories (87155). 1200 w. Times Engng Supp—May, 1918. Extension of home supplies. Abstract of paper by W. J. Jones before Ceramic Society.

Report of Committee C-8 on Refractories (87000 N). 8 pp. Am Soc Test Mat—June, 1918. Proposed revisions in tentative methods for ultimate chemical analysis, and method for determination of porosity.

The Necessity for Inspection and Testing of Refractory Brick (87001 N). C. E. Nesbitt and M. L. Bell. Ills. 9 pp. Am Soc Test Mat—June, 1918. Lack of uniformity of product shows the necessity.

To avoid error, please order by title and number only.

Rubber

Report of Committee D-11 on Rubber Products (87005 N). 15 pp. Am Soc Test Mat—June, 1918. Proposed tentative specifications for braided leader hose, rubber belting, and steam hose.

Rubber Substitutes (86898 A). Andrew H. King. Ills. 5500 w. Met & Chem Eng—June 15, 1918. Factors and limitations to be considered in studying rubber substitutes.

Steel

. No Sweeping Curtailment of Steel for Automobiles (86888). 2500 w. Auto Ind—June 13, 1918. War needs filled first. Full text of pig iron and steel agreement.

Report of Committee A-1 on Steel (86984 N). 50 pp. Am Soc Test Mat—June, 1918. Recommendations affecting standards and tentative standards.

Sur L'Hétérogénéité Des Aciers (87116 C + D). G. Charpy and S. Bonnerot. Ills. 1000 w. Revue De Métallurgie—Mar.-Apr., 1918. Micrographs showing heterogeneity of steel composition and molecular structure.

Sur L'Hétérogénéité Des Aciers (87115 C + D). H. Le Chatelier and E. L. Dupuy. Ills. 1100 w. Revue De Métallurgie—Mar.-Apr., 1918. Heterogeneity of steels. Illustrations of metallic structure by means of micrographs.

Selecting Steel by the Spark Method (87075 A). J. D. Keller, in *Blacksmith and Wheelwright*. Ills. 3500 w. Mech Wld—June 7, 1918. Methods used in selecting steel, and faults of some of them; how to make the spark test, its use, etc.

Textiles

Report of Committee D-13 on Textile Materials (86988 N). 20 pp. Am Soc Test Mat—June, 1918. Proposed tentative general methods for testing, with regulations governing the committee on this subject.

Timber

Report of Committee D-7 on Timber (86982 N). 9 pp. Am Soc Test Mat—June, 1918. Reports on wooden paving blocks and on timber preservatives.

Wrought Iron

Report of Committee A-2 on Wrought Iron (86983 N). 13 pp. Am Soc Test Mat—June, 1918. Recommendations and comments.

Zinc Dust

The Evaluation of Zinc Dust: A Proposed Method of Analysis (86996 N). L. A. Wilson. 11 pp. Am Soc Test Mat—June, 1918. From the viewpoint of its metallic zinc content.

MEASUREMENT

Airplane Wings

Transverse Testing Under Non-Uniformly Distributed Load With Special Application to Airplane Wing Ribs (86991 N). Irving H. Cowdrey. Ills. 19 pp. Am Soc Test Mat—June, 1918. Methods of testing are described.

Elastic Limit

Sumner Elastic Limit Recorder (86992 N). J. L. Jones and C. H. Marshall. Ills. 6 pp. Am Soc Test Mat—June, 1918. A semi-automatic solenoid device and method of operation.

Equilibrium Diagram

The Iron Carbon Equilibrium Diagram and Its Practical Usefulness (86582 N). H. C. H. Carpenter. Ills. 24 pp. Instn Nav Archts—March 21, 1918. Aims to show how the diagram has been constructed, and its practical usefulness to the engineer.

Explosives

Method of Calculating Comparative Strength and Efficiency of High Explosives from Their Composition and Apparent Densities (86763 B). Charles E. Waller. 3500 w. Jl Ind & Eng Chem—June, 1918. Method often useful in making up a formula for an explosive to be used for a certain class of work.

Gases in Metals

A Precision Method for the Determination of Gases in Metals (86977 N). H. M. Ryder. 6 pp. Am El Chem Soc—April, 1918. Details of method for measuring and analyzing the gas.

Hardness.

The Definition of Hardness (86707 A). W. Cawthorne Unwin. 700 w. Engng—May 17, 1918. Shows the identity of Martel's and Brinell's hardness numbers.

A New Method of Obtaining Brinell Hardness (87032 N). J. G. Ayers, Jr. Ills. 6 pp. Am Soc Test Mat—June, 1918. Results obtained in an endeavor to design a new type for commercial testing.

A Simple Type of Brinell Testing Machine for 500 Kg. Load (86990 N). A. V. de Forest. Ills. 11 pp. Am Soc Test Mat—June, 1918. Description, measurements, and suggestions.

Industrial Gases

Measuring Gas Electrically (87183 N). J. C. Wilson, with discussion. Ills. 152 pp. Assn I S E E—March, 1918. Economic features underlying the large quantity measurement of industrial gases.

Instruments

Contour- and Radius-Measuring Instrument (86664 A). Ills. 1500 w. Machy—June, 1918. Universal type for measuring irregular profiles, radius gages, and contours that cannot be tested by ordinary devices.

Predicting Instruments (87184 B). Ills. 14 pp. U S Art, Jl—Jan.-April, 1918. Descriptions, plans, and photographs of predictors, which have been recently submitted for test.

Mechanical Hysteresis

Study of Mechanical Hysteresis Will Advance Our Knowledge of Materials (86618). Frederick J. Schlink. 3000 w. Eng News-Rec—May 30, 1918. Failure under repeated stress apparently related to loss of energy in stress.

Micrographs

Report of Committee E-4 on Magnification Scales for Micrographs (86981 N). 4 pp. Am Soc Test Mat—June, 1918. Suggested amendments to the tentative definitions and rules governing the preparation of micrographs of metals.

Rails

Bending or Flexure of Railway Rails (86612). From *Le Genie Civil*. 2200 w. Eng & Con—May 29, 1918. A study of the bending stresses in railway rails, by M. Caufourier, with a new hypothesis.

Springs

Abaque Pour LLe Calcul Des Ressorts A Boudin (87141 B). R. Vanson. Ills. 3100 w. Génie Civil—May 25, 1918. Curves for calculation of springs under varying conditions of load. Mathematical.

Tank Contents

Improved Method for Finding Contents of Cylindrical Tanks (86665 A). Carlo M. Eyster. Ills. 800 w. Machy—June, 1918. Improved chart and its use.

Testing Machines

Report of Sub-Committee III, of Committee D-13, on Testing Machines (87031 N). Ills. 10 pp. Am Soc Test Mat—June, 1918. Deals with textile testing machines

Some Continental Testing Machines (86725 A). H. S. Primrose and J. S. Glen Primrose. Ills. 5000 w. Ir & Cl Trds Rev—April 19, 1918. Abstract of paper before the Iron & Steel Inst. Deals with tensile testing machines, torsion testing, impact testing, etc.

Some Useful Testing Machines (86813 N). H. S. Primrose and J. S. Glen Primrose. Ills. 45 pp. West Scot I & S Inst, Jl—Jan.-Feb., 1918. Tensile and impact testing machines and their applications.

Testing Methods

Report of Committee E-1 on Methods of Testing (86989 N). Ills. 23 pp. Am Soc Test Mat—June, 1918. Proposed revisions in standard methods. Effect of size and form of specimens.

Viscosity

The Variable Pressure Method for the Measurement of Viscosity (86999 N). E. C. Bingham. 10 pp. Am Soc Test Mat—June, 1918. Difficulties encountered and advantages to be derived by modifying the present capillary tube viscosimeters so as to use variable pressures.

The Standard Saybolt Universal Viscosimeter (86986 N). Winslow H. Herschel. 10 pp. Am Soc Test Mat—June, 1918. Methods for determining an equation for instruments of standard dimensions.

Water Power

Détermination Des Dimensions Les Plus Advantageuses D'Une Installation De Force Hydraulique (87136 B). E. Baticle. 3000 w. Génie Civil—May 11, 1918. Deduction of mathematical expressions for the best dimensions of the principal elements of an hydraulic plant.

Wind Recorder

A Simple Automatic Wind-Direction Recorder (86646). James Robertson. Ills. 800 w. Eng & Min Jl—June 1, 1918. The apparatus is used in smelter fume investigations.

POWER AND TRANSMISSION

Air Compressors

High Pressure Air Compressor Design and Application (86600). Joseph M. Ford. Ills. 4500 w. Mar Eng, Can—May, 1918. Serial, 1st part. Deals with machines which produce high pressure air, and their advantages.

India

Water Power in India (86697 A). Alfred Dickinson, with discussion. 7500 w. Roy Soc Arts, Jl—May 17, 1918. Schemes already developed and possible water powers are briefly considered.

Lubricators

Lubricators—Their Construction and Maintenance (86821 A). Ills. 1800 w. Ry & Loc Eng—June, 1918. Care of automatic appliances necessary.

Power

Conditions in the Power Industry (86660). Ludwig W. Schmidt. 2500 w. Power—June 4, 1918. Power situation in various parts of the world.

See also Power, under INDUSTRIAL MANAGEMENT, *Management*.

STEAM ENGINEERING

Boiler Rooms

Improving Boiler-Room Operation (87043). I. L. Kentish-Rankin. Ills. 3000 w. Elec Rev, Chi—June 15, 1918. Need of improved apparatus and methods, and use of indicating instruments.

Boiler Test

Performance Test of Steam Boilers (86671). H. A. Cozzens, Jr. Ills. 5000 w. Natl Engr—June, 1918. Methods used in the average power plant.

Coke

See same heading under Mining and Metallurgy, *Coal and Coke.*

Efficiency

Improving the Efficiency of Boiler Plants (87133 C). G. E. Williamson. Ills. 3800 w. Paper—May 22, 1918. Read before Tech Assoc Pulp & Paper Industry, at Dayton, O., May 16, 1918.

Exhaust Steam

Considérations Sur L'Utilisation Des Vapeurs D'Échappement (87118 B). A. Barjou. 4500 w. L'Industrie Électrique—May 10, 1918. Use of exhaust steam at coal mine plants for development of electric energy.

Feed Water

Losses and Trouble Caused by Impure Boiler Feed Water (86755 A). H. H. Mapelsden. Ills. 700 w. Gen Elec Rev—June, 1918. Special reference to the use of steam and water flow meters.

Fuels

The Use of Powdered Coal (87172). W. G. Wilcox. Ills. 3000 w. Min & Sci Pr—June 22, 1918. Read before Am. Chem. Soc. Possible solution of fuel shortage problem.

The Use of Pulverized Coal (86610). Ch. Dantin, in *Le Genie Civil.* 2200 w. Eng & Con—May 29, 1918. Types of furnaces and principles on which experiments were based.

Pitch as a Fuel for Power Generation (87175). John B. C. Kershaw. 3000 w. Power—June 25, 1918. Summary of the most recent patents and experiments relating to the use of coal-tar pitch as a fuel for steam boilers and internal combustion engines.

Gas Firing

Gas Firing Boilers (87079 A). T. M. Hunter. From paper read before S. Wales Inst. of Engrs. 3500 w. Colly Gdn—May 31, 1918. Essentials of the economical combustion of gas.

Discussion on "Gas Firing Boilers" (86805 N). 6000 w. Instn E E, Jl—May, 1918. Discussion at the Newcastle Local Section, Feb. 4, 1918.

Oil Fuel

Economical Method of Burning Fuel Oil (86690 A). Ills. 2500 w. Int Mar Eng—June, 1918. Fifty per cent. increase in economy claimed for Sklovsky, or "Oilgas" furnace developed by General Combustion Co.

Oil Fuel in New England Power Plants (86684 A). Henry W. Ballou. (Abstract.) Ills. 2500 w. A S M E, Jl—June, 1918. Brief statement of the present status. Rapid increase.

Power Plants

Remodeling the St. Louis Baden Station (86921). K. Toensfeldt. Ills. 1700 w. Power—June 18, 1918. Will contain four boilers from old station and four new boilers of same size. Reconstruction without interruption of service.

Soot

Avoiding a Preventable Loss (86787). 3500 w. Elec Wld—June 8, 1918. Loss from soot formation, and methods of removing soot.

Soot and Soot Blowers (86795). 3500 w. Power—June 11, 1918. Nature of soot and its effect on heat transfer through boiler-heating surfaces. Mechanically operated soot blower versus hand cleaning.

Steam Flow

Effect of Feed-Water Temperature and Rate of Injection Upon Steam Flow (87178). Frank G. Philo. 600 w. Power—June 25, 1918. Chart showing effect, with explanation.

Turbines

Interpreting Steam-Turbine Test Curves (86922). H. E. Brelsford. 1100 w. Power—June 18, 1918. Standard turbine data curves and how they are derived and used.

Milestones in Small Turbine Development (86750 A). Ivan Stewart Forde. Ills. 2500 w. Elec Jl—June, 1918. Their rapid increase in popularity, the requirements, applications, etc.

The New Commonwealth Edison Turbine (86747 A). J. F. Johnson. Ills. 5000 w. Elec Jl—June, 1918. Details of unit recently installed in the Northwest station, Chicago.

TRANSPORTING AND CONVEYING

Ash Handling

Economic Handling of Ashes (87091 A). Reginald Trautschold. Ills. 3000 w. Ind Man—July, 1918. Latest developments in mechanical ash handling equipment with approximate costs.

Coal Handling

Coal-Handling Plant at the Saltley Gas-Works (86709 A). George Frederick Zimmer. Ills. & Plate. 3500 w. Engng—May 17, 1918. Detailed description.

Conveyors

Discussion of Mr. Harold C. Jenkins' Paper on "Underground Conveyors" (87084 N). 7 pp. Instn Min Engrs, Trans—May, 1918.

Cranes

Build Huge Crane for Shipyard Use (86586 A). Ills. 2000 w. Mar Rev—June, 1918. Will have lifting capacity of 392 net tons.

Handling

Meeting Increasing Industrial Demands (86650). Ills. 3300 w. Pwr Pt Eng—June 1, 1918. Monorail coal and ash handling equipment and unique electric distribution system.

Material Handling

How to Move Materials by Machinery (87097 A). Henry J. Edsall. Ills. 4000 w. Ind Man—July, 1918. Applications of various types of elevating and conveying machinery to load, unload and transport materials.

MISCELLANY

Gas Attacks

American Chemists' Defensive Measures Against Gas Attacks in France (86899 A). Robert K. Tomlin, Jr. Ills. 2200 w. Met & Chem Eng—June 15, 1918. Method devised for meeting attacks of poison gas.

ELECTRICAL ENGINEERING

COMMUNICATION

Automatic

Automatic Telephones At Leeds (87151). 1000 w. Times Engng Supp—May, 1918. New automatic exchange recently put in operation in Leeds, England.

Leeds Automatic Telephone Exchange (86828 A). Ills. 1500 w. Elec Rev—May 24, 1918. Full automatic of the Strowger type, for a five figure system.

Interference

Interference — Its Legal Status (87026 A). J. A. Whitlow. 5000 w. Tel Engr—June, 1918. Read before Univ. of Missouri, A. I. E. E.

Iowa Inductive Interference Case (87059). Harold L. Beyer. 3000 w. Telephony—June 22, 1918. Decision of Iowa Railroad Commission in Iowa High Tension case, and other legal questions.

Telephony

Transmission of Cord Circuits (86957). Walter C. Freeman. 3000 w. Telephony—June 8, 1918. Various types of magneto cord circuits.

ELECTRO-CHEMISTRY

Copper Precipitation

The Effect of Iron Sulphate in the Electrolytic Precipitation of Copper from Sulphate Solution with Insoluble Lead Anodes (86972 N). Edward F. Kern. 11 pp. Am El Chem Soc—April, 1918. Experimental investigations and results.

Electric Furnace

A vom Baur Arc Furnace (86974 N). J. H. vom Baur. Ills. 6 pp. Am El Chem Soc—April, 1918. A new design for melting ferro-manganese or ferrosilicon, or melting down cold charges for steel castings.

The Booth-Hall Electric Furnace (86973 N). W. K. Booth. Ills. 10 pp. Am El Chem Soc—April, 1918. A newly-designed electric steel furnace of the vertical-arc type with conducting hearth.

Electrometallurgy

Electric Furnace for Forging and Annealing of Steel (86914). Wirt S. Scott. Ills. 3500 w. Elec Rev, Chi—June 8, 1918. Abstract from paper before Assn. of Iron & Steel Elec. Engrs. Development of modern furnace for this purpose.

Electric Steel Castings (86979 N). R. F. Flinterman. 8 pp. Am El Chem Soc—April, 1918. Report of foundry experience.

Electrolytic Refining of Tin (86976 N). Edward F. Kern. 12 pp. Am El Chem Soc—April, 1918. Experiments to determine the best electrolyte, the best current density, and the best addition agent to use, with the object of saving the precious metals and getting pure tin.

The Electric Furnace for Annealing Treatment and Forging of Steel (87160 N). Wirt S. Scott, with discussion. Ills. 15 pp. Assn I S E E—April, 1918. Facts relating to a furnace developed by the Westinghouse Electric & Mfg. Co.

Electroplating

Experiments with the Copper Cyanide Plating Bath (86980 N). 5 pp. Am El Chem Soc—April, 1918. Experiments to study the increase in copper concentration.

Silver Deposit

Process of Depositing Silver on Glass and China (87027). Howard Pearsall. 1800 w. Brs Wld—June, 1918. Information and formulae.

Storage Batteries

Electric Storage Batteries (86653). Ills. 1800 w. Pwr Pt Eng—June 1, 1918. Serial, 1st part. Their construction, theory of operation, care, installation, and application.

See also same heading under Marine and Naval Engineering.

ELECTRO-PHYSICS

Alloys

Thermo-Electromotive Force of Some Alloys (86975 N). M. A. Hunter and J. W. Bacon. 13 pp. Am El Chem Soc —April, 1918. A study at different temperatures.

Electrical Sensitivity

Photoelectric Sensitivity of Bismuthinite and Various Other Substances (87159). W. W. Coblentz. 15 pp. U S Bur Stds, Sci paper 322—June 14, 1918. Summarizes results of an examination of various substances.

GENERATING STATIONS

Business Methods

War's Influence on Central-Station Selling (86790). 2500 w. Elec Wld—June 8, 1918. Changes in business methods forced by prohibitive cost of extensions.

Central Stations

Central Station vs. Isolated Plant (86674). W. H. Wakeman. 2000 w. Natl Engr—June, 1918. Cost not always the deciding factor.

The Central Station and Illumination (86762 A). H. E. Mahan. Ills. 3000 w. Gen Elec Rev—June, 1918. Treated from the standpoint of central station policy and rendering expert service to the customer.

Conservation

War Conservation of Power and Light (87179). 2500 w. Elec Rev, Chi —June 22, 1918. Programme of U. S. Fuel Administration affecting central station companies.

Coöperation

Compulsory Co-operation of Central Station and Isolated Plant (86923). S. R. Sague. 3000 w. Power—June 18, 1918. Advisability of coöperation to avoid duplication of distributing systems and prevent waste of coal.

Hydro-Electric

Chippawa-Queenston Power Development (87056). Ills. 5000 w. Can Engr —June 20, 1918. Development at Niagara, the largest hydro-electric power scheme ever undertaken.

Electric Power for Mining in Yavapai County, Arizona (87068). P. R. Milnes. Ills. & Map. 1800 w. Eng & Min Jl—June 22, 1918. Describes hydro-electric plant on Fossil Creek, distributing power from sub-stations at Jerome and Clarkdale.

The Pearson Hydro Electric Development in Catalogne, Spain (86615). Ch. Dantin, in *Le Genie Civil.* Ills. 2500 w. Eng & Con—May 29, 1918. General features of the development.

The Tasmanian Hydro-Electric Department (86870 A). Ills. & Map. 1500 w. Aust Min Stan—Apr. 25, 1918. The King River power scheme described.

Trebling the Capacity of a Hydro-Electric Plant During Operation (86616). Byron S. White. Ills. 2000 w. Eng News-Rec—May 30, 1918. Trenton Falls development in Adirondacks.

Loads

Improved Industrial Lighting Offers Timely Load (87042). F. H. Bernhard. 2000 w. Elec Rev, Chi—June 15, 1918. Intensive production calls for better lighting.

The Central Station and the Industrial Electric Heating Load (87041). Arthur F. Allsop. Ills. 3000 w. Elec Rev, Chi—June 15, 1918. Serial, 1st part. Shows this load to be worthy of development.

Power Factor

Power Factor and Its Improvement (86852 A). E. W. Dorey. 1800 w. Elec'n—May 24, 1918. Serial, 1st part. Causes of low power factor, and whether the cost of improvement should be borne by the consumer or by the supply.

GENERATORS AND MOTORS

Flashing

Protection from Flashing for Direct Current Apparatus (86952 D). J. J. Linebaugh and J. L. Burnham. Ills. 11 pp. A I E E, Pro—June, 1918. Describes equipment applicable to all d. c. apparatus and all methods of operation.

Generators

Un Moyen De Forcer La Puissance D'Un Générateur Électrique (87120 B). C. Vallet. 2200 w. L'Industrie Électrique—May 25, 1918. Methods in use for keeping the running temperature of a generator within certain limits while increasing the kilowatt output of the machine.

Motors

Standardized Motors for the Steel Industry (87182 N). W. T. Snyder, with discussion. 16 pp. Assn I S E E—March, 1918. A plea for standardization.

Rotary Converters

Utilité Des Convertisseurs Ou Transformateurs Tournants (87119 B). J. A. Montpellier. Ills. 2000 w. I'Industrie Électrique—May 25, 1918. Use of rotary converters and general conditions governing their installation.

Starting Motors

Large Single-phase Starting Motors (86761 A). W. C. K. Altes. Ills. 1800 w. Gen Elec Rev—June, 1918. Last of a series of articles on a. c. motors. Shows how the problem of building a large single-phase starting motor was solved economically, application, etc.

ILLUMINATION

Factories

Better Lighting of Machine Shops (86634). F. H. Bernhard. Ills. 5500 w. Elec Rev, Chi—June 1, 1918. Serial, 1st part. First of 12 articles dealing with improved lighting in as many industries.

Industrial Lighting for Shops (87170). O. L. Johnson. Ills. 1000 w. Ry Rev —June 22, 1918. Importance of proper illumination.

Flickering

Flickering of Electric Lamps (86825 A). K. Simons. Abstract from *Electro. Zeit.*. 1500 w. Elec'n—May 17, 1918. Report of tests made to determine conditions causing flickering with a varying source of light, and other related points.

Lamps

Les Nouvelles Lampes Électriques (87124 B). A. Soulier. Ills. 2400 w. La Nature—May 4, 1918. Review of recent progress in lamp development.

Mazda Lamps for Motion Picture Projection (86748 A). A. R. Dennington. Ills. 2000 w. Elec Jl—June, 1918. Lamps developed for this use and their advantages.

Lighting Economy

Lighting Economy in War Time (86751 A). Preston S. Millar. Ills. 3000 w. Elec Jl—June, 1918. Suggestions of value in anticipation of serious fuel shortage during the coming winter.

Light Projection

Motion Picture Projection with Tungsten Filament Lamps (86925 C). J. T. Caldwell, A. R. Dennington, J. A. Orange, and L. C. Porter, with discussions. Ills. 7000 w. Ill Eng Soc Trans—June 10, 1918. Account of the development. Advantages and disadvantages of the several systems.

NELA

The N. E. L. A. "Win the War" Convention (86896). Ills. 20 pp. Elec Wld—June 15, 1918. Report of proceedings at Atlantic City meeting.

John W. Lieb's Presidential Address (87062). 2500 w. Elec Wld—June 22, 1918. From committee report on the address at Atlantic City, discussing "The Electrical Industry in War Service."

Protective Lighting

The Effective Application of Protective Lighting (86897). H. H. Magdsick. Ills. 2500 w. Elec Wld—June 15, 1918. Requirements. Improper distribution of light a common fault.

Protective Lighting for Manufacturing Plants (86753 A). W. A. McKay. 2000 w. Elec Jl—June, 1918. Systems for guarding plants and grounds at night from enemy interference.

Protective Lighting for Industrial Plants (86637). Davis H. Tuck. Ills. 1000 w. Elec Wld—June 1, 1918. Discusses required intensity and distribution of illumination, glare, available units, and desirable methods.

Rockets

Rockets and Illuminating Shells as Used in the Present War (86924 C). A. Bergman, with short discussion. 4000 w. Ill Eng Soc, Trans—June 10, 1918. Description and use.

Searchlights

Development of Electric Searchlight lamps (87067). Louis J. Auerbacher. Ills. 2500 w. Elec Wld—June 22, 1918. Explains newest principle

Streets

Ornamental Utilitarian Street Lighting Units (86760 A). S. L. E. Rose and H. E. Butler. Ills. 900 w. Gen Elec Rev—June, 1918. Companion article to one appearing in Dec. number of Gen. Elec. Rev. giving data on new types of units.

MEASUREMENT

Insulators

The Electrical Resistivity of Porcelain and Magnesia at High Temperatures (86978 N). P. H. Brace. Ills. 7 pp. Am El Chem Soc—April, 1918. Report of tests.

Meters

An Electrolytic Metering Case (86826 A). Ills. 1800 w. Elec'n—May 17, 1918. A device designed to take the place of the d. c. watt-hour meter for small customers.

Testing Laboratory

British Electrical Proving House (87150). 1400 w. Times Engng Supp—May, 1918. Benefits to industry expected from a general testing laboratory for manufacturers.

Voltmeters

Voltmeter Multipliers (86673). E. C. Parham. Ills. 4000 w. Natl Engr—June, 1918. Five quantities to be considered; the formula and its applications.

POWER APPLICATIONS

American

America's Energy Supply (86951 D). Charles P. Steinmetz. 24 pp. A I E E, Pro—June, 1918. Requirements for the economical utilization of the country's energy supply.

Electric Heating in Manufacturing (87099 A). Thomas Robson Hay. 2800 w. Ind Man—July, 1918. Advantages and disadvantages; points in installing and operating.

Mining

Some Practical Considerations on Electrical Engineering (87077 A). Chris Jones. 4500 w. Colly Gdn—May 31, 1918. Abstract of paper before S. Wales Inst. of Engrs. Questions on transmitted power. Periodicity of supply, power factor, earth and insulated neutral, cables, transformers, motors, etc.

Requirements, Operation, and Maintenance of Colliery Power Station Switchboards (86771 A). L. Fokes. Diagrams. 5500 w. Colly Gdn—May 10, 1918. Reviews the complete equipment of a power station switchboard indicating the reasons for installing the various apparatus and meters.

Rolling Mills

Rolling Mills and the Electric Drive (86851 A). L. Rothera. Abstract of paper before the Manchester Assn. of Engrs. 2500 w. Elec'n—May 24, 1918. Increasing development as compared with steam methods, giving diagrams showing the relation between power demanded and time.

Steel Works

Electrical Plant In Steel Works (87146). 2000 w. Times Engng Supp—May, 1918. Roll motors, lifting magnets, etc., as used in England.

TRANSFORMERS

Banking

Banking of Distribution Transformers (86915). P. O. Reyneau and H. Cole. 1500 w. Elec Rev, Chi—June 8, 1918. Fundamental considerations of arrangement involving economy and quality of service.

Indicator

Temperature Indicator for Transformer Winding (86756 A). V. M. Montsinger and A. T. Childs. Ills. 3000 w. Gen Elec Rev—June, 1918. Proposed schemes, and benefits derived, with details of a recently developed indicator.

TRANSMISSION AND DISTRIBUTION

Cables

Aerial Cable Construction for Electric Power Transmission (86949 D). E. B. Meyer. Ills. 10 pp. A I E E, Pro—June, 1918. Problem of supplying high-tension electric service where conditions do not permit the use of open wire or underground circuits.

Duct Splicing Saves Short Lengths of Cable (86789). J. B. Noe and A. Rabe. Ills. 1200 w. Elec Wld—June 8, 1918. How splice diameter is minimized.

Concrete Poles

Concrete Poles Are in the Process of Evolution (86881). Charles Rufus Harte. Ills. 2200 w. Elec Ry Jl—June 15, 1918. Merits and developments.

Copper Resistance

The Standard Resistance and Temperature Coefficient of Pure Annealed Copper (86829 A). H. Savage. 1500 w. Elec Rev—May 24, 1918. Directions for calculating the resistance of electrical conductors.

Copper Wire

Economical Use of Copper (86788). P. O. Reyneau. 2000 w. Elec Wld—June 8, 1918. Shows that not enough attention is given to the removal of wire not effective in distribution systems.

Faults

Some Notes on Loop Tests for Fault Localization (86827 A). G. W. Stubbings. 1200 w. Elec'n—May 17, 1918. Describes tests and apparatus used.

Interconnection

Benefits Possible from Interconnection (86784). Ills. 1600 w. Elec Wld—June 8, 1918. Analysis of conditions in Eastern Massachusetts, and the possibilities.

Insulators

Application of Theory and Practise to the Design of Transmission Line Insulators (86950 D). G. I. Gilchrest. Ills. 20 pp. A I E E, Pro—June, 1918. Considers old types of insulators and causes of failures; describes proposed type and its advantages.

Lightning Arresters

Selecting Lightning Arrester Types to Suit Requirements (86886). Q. A. Brackett. Ills. 1700 w. Elec Ry Jl—June 15, 1918. Applicability of electrolytic, multipath, and condenser types to several classes of service; suggestions for installation and maintenance.

The Oxide Film Lightning Arrester (86947 D). Crosby Field. Ills. 10 pp. A I E E, Pro—June, 1918. Statement of the scientific principles of a new type.

The Oxide Film Lightning Arrester (86948 D). Charles P. Steinmetz. Ills. 9 pp. A I E E, Pro—June, 1918. Development of lightning arresters reviewed and a description given.

Lightning Protection

Lightning Protection for Special Transmission Lines (86749 A). G. C. Dill. Ills. 1200 w. Elec Jl—June, 1918. Applications of lightning protection apparatus, especially of electrolytic lightning arresters.

Networks

Method of Symmetrical Co-ordinates Applied to the Solution of Polyphase Networks (86953 D). C. L. Fortescue. 87 pp. A I E E, Pro—June, 1918. Mathematical.

Power Lines

Long Spans Facilitate Mountain Service (87063). N. B. Hinson. Ills. 1000 w. Elec Wld—June 22, 1918. Features of construction of power lines.

Relays

Recent Protective Relay Developments (86752 A). E. A. Hester. Ills. 3500 w. Elec Jl—June, 1918. Relays furnishing protection against overheating, power reversal and phase reversal.

Steel Circuits

Steel Conductors for Series Circuits (87065). L. M. Klauber. 2000 w. Elec Wld—June 22, 1918. Facts that determine the choice between steel and copper; formula and application.

Supply Schemes

Small Generating Stations and Electricity, Supply Schemes (86699 N). R. F. Botting, with discussion. 6500 w. So Af Instn Elec Engrs, Trans—March, 1918. Refers chiefly to municipal schemes for the supply of electricity for lighting and power in small towns.

MISCELLANY

Conservation

War Conservation of Power and Light (86783). Charles E. Stuart. 3500 w. Elec Wld—June 8, 1918. General plans laid out by the Bureau of Conservation of the U. S. Fuel Administration.

War Service

War Service of the Electrical Manufacturers (87066). Robert K Sheppard 1800 w. Elec Wld—June 22, 1918. From report of general war service committee of Electric Power Club

CIVIL ENGINEERING

BRIDGES

Bascule

Pont Basculant De 42 Mètres De Portée (87137 B). A. Goupil. Ills. 1800 w. Génie Civil—May 18, 1918. A bascule bridge recently built on Trollhättan Canal, Sweden, with lift span 137 ft. 9 in. long.

Castleton

State Law Limits Castleton Bridge to Single Span (86617). 1500 w. Eng News-Rec—May 30, 1918. Act prohibits center pier for Hudson River bridge.

Hudson Bay

Difficult Bridge Construction in a Cold Country (86847). W. Chase Thomson. Ills. 3500 w. Ry Age—June 14, 1918. Hudson Bay railway trusses over Kettle Rapids are continuous over four supports.

Long Spans

Economics of Long-Span Bridges (86801). Charles Evan Fowler. 3000 w. West Eng—June, 1918. Considerations that govern selection of site, length of span, and type of bridge.

Military Bridges

The Marcille and Henry Types of Military Bridges in France (86606). A Bidault des Chaumes, in *Le Genie Civil.* Ills. 1500 w. Eng & Con—May 29, 1918. Types, and methods of erection.

Reconstruction

Rapid Reconstruction of Stone Masonry Bridges by Use of Metal Frames and Concrete Arches. From *Ann. des Ponts et Chaussées.* Ills. 1800 w. Eng & Con—May 29, 1918. Outlines method used for rebuilding after battle of the Marne.

Viaducts

Concrete Viaduct at St. Louis Has Simple Details (86694). Charles W. Martin. Ills. 2000 w. Eng News-Rec—June 6, 1918. Structure carrying Chouteau Ave. over railroad made up of short slab spans on three post piers.

Road Along Rock and Shale Bluff Requires Walls and Viaduct (86876). Ills. 1500 w. Eng News-Rec—June 13, 1918. Details of work in Kansas City.

World's Bridges

The Principal Bridges of the World—A Comparison (86833 A). Plate. 4000 w. Engr—May 24, 1918. Serial, 1st part. Sketches made to the same scale of drawing comparing as to size, importance, design, etc.

See also Canals, under Waterways and Harbors.

To avoid error, please order by title and number only.

CONSTRUCTION

Building

L-Évolution Scientifique De L'Art De Batir (87117 B). C. Rabut. Ills. 7700 w. Revue Générale des Sciences—Apr. 30, 1918. Development of the art of building exemplified in modern structures.

Cement Gun

Facilitating the Construction of Water and Sewerage Works by Means of the Cement-Gun (86677 A). Ills. 1500 w. Mun Eng—June, 1918. Examples of successful application of the cement-gun process.

Cantonments

Cantonment Construction (86838 B). Morris Knowles. Plans & Ills. 35 pp. Engrs Soc W Penn—March, 1918. Problems connected with the housing and living conditions of soldiers during their early training.

Concrete

City Designs Forms for Portland Grade Separation (86875). Ills. 1200 w. Eng News-Rec—June 13, 1918 Methods of handling concrete for abutments and retaining walls.

Designing Wall Beams in Concrete Flat-Slab Buildings (86873). Albert M. Wolf. Ills. 2500 w. Eng News-Rec—June 13, 1918. Reinforcement details governed by construction.

Dams

See same heading under Water Supply.

Factories

How a Chain Factory Was Built and Then Occupied (87006 A). Charles Lundberg. Ills. 2500 w. Iron Age—June 20, 1918. Details of a factory in Indianapolis employing 1,000 employees and between 600 and 700 machines.

New Plant of Diamond Chain Company (87093 A). Ills. 1000 w. Ind Man—July, 1918. Features of buildings and equipment for manufacturing roller chain and sprockets for power transmission.

Garage

Main Beams in Concrete Garage Are Forty-nine Feet Long (86623). Ills. 1200 w. Eng News-Rec—May 30, 1918. Garage recently erected in Pittsburgh, Pa.

Halifax

Reconstruction of Devastated Halifax (87058). Ills. 6000 w. Can Engr—June 20, 1918. Describes relief organization and methods and the rapid recovery of this maritime port.

Housing

Engineering Data Required for a Housing Project (86877). 2500 w. Eng News-Rec—June 13, 1918. Federal Bureau of Housing of Department of Labor issues instructions to be followed by preliminary investigators.

How Erie Is Solving the Housing Problem (86594 A). Ills. 2500 w. Iron Age—May 30, 1918. Details of house-building work.

The Workman's Home: Its Influence Upon Production in the Factory and Labor Turnover (86685 A). Leslie H. Allen. 7000 w. A S M E, Jl—June, 1918. Housing of the working classes in America.

Retaining Walls

Novel Type of Retaining Wall and Calculations for Its Design (86611). From Ann. des Ponts et Chaussees. 1500 w. Eng & Con—May 29, 1918. Features of a reinforced concrete retaining wall and service results.

Tunnels.

Repairing Tunnel Linings with Gunite (87024). 1200 w. Com Air—June, 1918. Tunnels on the Northern Pacific. Work described.

Warehouses

Small Army Warehouses Built with Speed and Economy (86621). Ills. 1200 w. Eng News-Rec—May 30, 1918.

IRRIGATION AND RECLAMATION

California

Canal Over Divide Raises Storage Service Factor (87017). Ills. 2000 w. Eng News-Rec—June 20, 1918. Concrete lining reduces seepage; rip rap checks erosion.

Mesopotamia

Irrigation in Mesopotamia (87153). 1000 w. Times Engng Supp—May, 1918. Recent developments, canal system, the Willcocks scheme, etc.

De herbevloeüng van Mesopotamie (87108 B). R. G. Hoeffelman. Ills. 10400 w. Ingenieur—Mar. 23, 1918. Characteristics of the delta of the Euphrates and Tigris rivers. Canals, irrigation, climate, floods, navigation, and development.

Reclamation

Vast Scheme of Land Reclamation Proposed by Secretary Lane (87044). 2000 w. Eng & Con—June 19, 1918. Abstract of a letter to the President suggesting work to meet the requirements of returning soldiers.

MATERIALS OF CONSTRUCTION

Aggregates

An Abrasion Test for Stone, Gravel, and Similar Aggregates (87037 N). H. H. Scofield. Ills. 9 pp. Am Soc Test Mat—June, 1918. Describes apparatus aiming to furnish a simpler machine and a more rapid and practical test.

Proportioning the Materials of Mortars and Concretes by Surface Areas of Aggregates (87036 N). L. N. Edwards. Ills. 48 pp. Am Soc Test Mat—June, 1918. Information for securing uniformly strong mortars and concretes.

Niter Cake

A Summary of the Proposals for the Utilization of Niter Cake (86764 B). John Johnston. 3500 w. Jl Ind & Eng Chem—June, 1918. Shows the possibilities of its utilization.

Sampling

The Sampling of Deposits of Road Stone and Gravel in the Field (87038 N). L. Reinecke and K. A. Clark. 20 pp. Am Soc Test Mat—June, 1918. Studies upon variations in the road-making qualities of bed rock, boulder aggregates, and gravel.

MEASUREMENT

Water-Tester

Dionic Tester in Waterworks Service (86767). Joseph Race. Ills. 900 w. Can Engr—June 6, 1918. Its use in the detection of leakages from mains; the estimation of universal matter in natural waters; and the examination of distilled water.

MUNICIPAL

Camps

Camp Management (86907 N). H. D. Symmes. 2500 w. Can Min Inst, Bul—June, 1918. Sanitation, management and handling of meat at labor camps.

Camp Sanitation (86880 B). W. P. Mason. 13 pp. Fkn Inst, Jl—June, 1918. Deals particularly with necessary precautions in labor camps.

City Planning

City Planning as an Engineering Problem (86682 A). Nelson P. Lewis. 2500 w. Mun Eng—June, 1918. Critical discussion of European city planning; elements of a proper plan; the engineer's responsibility and opportunity.

Dutch East Indies

Een Algemeen nitbreidings en verbeterings plan voor de gemeente Semarang (87111 B). H. Maclaine Pont. Ills. 5800 w. Ingenieur—May 4, 1918. Improvement plans for Semarang, Java.

Garbage

Wichita Shares Profits From Feeding Garbage to Hogs (87015). 2500 w. Eng News-Rec—June 20, 1918. Contractor collects and disposes of garbage paying city 10 per cent. net income.

Norfolk, Va.

Handling an Extra Hundred Thousand at Norfolk (87070). Map. 1800 w. Elec Ry Jl—June 22, 1918. Recent developments in this district.

Sewage Disposal

English Practice in Sewage Treatment and Disposal (86938). G. Bertram Kershaw. From presidential address. 3000 w. Eng & Con—June 12, 1918.

The Development of Sewage Treatment (86680 A). Kenneth Allen. Ills. 4000 w. Mun Eng—June, 1918. Early and recent methods of sewage disposal. The different processes.

The Miles Acid Process for Sewage Disposal (86657 A). Ills. 3500 w. Met & Chem Eng—June 1, 1918. Tests of a new chemical process.

Sewage Flow

Estimating Sewage Flow Based on Floor Area of Buildings (86939). Walter S. M'Grane. 1800 w. Eng & Con—June 12, 1918. From paper before Munic. Engrs. of the City of New York. Forecasting water consumption and sewage flow in commercial buildings.

Sewer Pipe

Report of Committee C-4 on Clay and Cement Sewer Pipe (86987 N). 6 pp. Am Soc Test Mat—June, 1918. Recommendations.

Sewers

Methods and Cost of Concrete and Brick Sewer Construction in Toronto (86935). From article by W. S. Harvey and R. T. G. Jack, in *The Contract Record*. Ills. 2000 w. Eng & Con—June 12, 1918. Details and costs.

Organization of Forces and Plant and Methods Employed in Construction of Sewers in Chicago (86676 A). Herbert E. Hudson. Ills. 4000 w. Mun Eng—June, 1918. Interesting features in efficiency, and field organization.

ROADS AND PAVEMENTS

Assessments

Paving and Grading Assessments on Simple Basis (86622). George H. Ruhling. 1000 w. Eng News-Rec—May 30, 1918. Satisfactory standard method in use for four years.

Bituminous Macadam

Causes of Failure of Bituminous Macadam Pavements (86933). Walter Leavitt. 1800 w. Eng & Con—June 5, 1918. Discusses causes of failure of bituminous pavements or roads constructed by penetration methods only.

British Roads

Our Roads and Their Future (86770 A). H. Percy Boulnois. Ills. 1800 w. Autocar—May 18, 1918. How the highways have fared under war conditions. Problems for road surveyors.

Concrete

Concrete Roads (86701 A). A. E. Wynn. Ills. 1800 w. Autocar—May 4, 1918. Serial, 1st part. Satisfactory results in Canada and United States after many years use.

Reinforced Concrete Highways (86799). W. B. Sawyer, Jr. Ills. 1500 w. West Eng—June, 1918. Reasons for formation of both longitudinal and transverse cracks, showing how they may be prevented.

Good Roads

Are Good Roads Remunerative to Municipalities? (86958). William D. Sohier. Ills. 2000 w. Can Engr—June 13, 1918. Increased taxes collected due to rise in land values.

Maintenance

Maintenance Methods for Sand-Clay and Top-Soil Roads (86934). Extracts from bulletin by R. T. Brown. 2500 w. Eng & Con—June 5, 1918. Practical suggestions.

Paving

Data on California Asphalt Paving Work Performed With Portable Asphalt Plant (86675 A). T. E. Stanton. Ills. 1500 w. Mun Eng—June, 1918. Data on Topeka surfacing placed on the wooden trestles on the Upper Stockton road. Work done under very trying conditions.

Road Materials

Report of Committee D-4 on Road Materials (87003 N). 12 pp. Am Soc Test Mat—June, 1918. Tentative standards and tests recommended.

Vibration

L'Habitation Et Les Trépidations De La Chaussée (87126 B). M. Bousquet. Ills. 2000 w. La Nature—May 11, 1918. Vibrations of pavements and buildings caused by heavy vehicles.

War Lessons

Lessons of the War as Applied to Roads and Bridges (87057). Walton Maughan. (Abstract.) 1500 w. Can Engr—June 20, 1918. Calls attention to new points brought out by the war.

WATER SUPPLY

British Columbia.

Water Resources of British Columbia (86768). William Young. Abstract of address before the B. C. Mfrs. Assn. 1200 w. Can Engr—June 6, 1918. The value of this resource in irrigation and water power.

Conduits

Formulas for Calculating Thickness and Reinforcement for Concrete Conduit (86936). L. Robert de la Mahotiere, in *Le Genie Civil.* [illegible] & Con—June 12, 1918. Calculations applied in connection with the new water system for Bankok.

Dams

Accident and Reconstruction of a Clay Puddled Dam (86604). A. Dumas, in *Le Genie Civil.* Ills. 1200 w. Eng & Con—May 29, 1918. [illegible] the Charmes dam, the accident, and method of repairing.

Dam Sites on the Missouri (86903 A). Doane Robinson. Maps & Ills. 2000 w. Pahasapa Qr—June, 1918. Abstract of an address at Dakota School of Mines. Projects for developing power.

New Type of Arch Dam (86700 N). Ills. 1200 w. Comwh Engr—April, 1918. Brief explanation of the principle, with short description of the Salmon Creek dam, Juneau, Alaska.

The San Pablo Dam (86797). Ills. 2000 w. West Eng—June, 1918. Hydraulic-fill dam now under construction near Richmond, Calif. The storage capacity will be 14,000,000,000 gals.

Filter Sand

Experience With Filter Sand at Columbus, O. (86937). 1100 w. Eng & Con—June 12, 1918. Information from last annual report of Charles P. Hoover.

Pumping Station

Mayfair Pumping Station (87018). John Ericson. Ills. 4500 w. Pwr Pt Eng—Jan. 15, 1918. Wilson Ave. system of Chicago water supply. Many features of special design.

Purification

Some Aspects of Chemical Treatment at St. Louis Waterworks (86959). A. V. Graf. 3000 w. Can Engr—June 13, 1918. One of a series of four papers read before the Am. W-Wks. Assn. The kind of water treated, improvement, and details of operation.

La Chloration (87121 B). Ills. 2700 w. La Nature—Apr. 27, 1918. American chlorination apparatus used for water purification for the army in France.

Some Results Secured by Chlorine Compounds in Water Purification and Sewage Treatment (86681 A). C. A. Jennings. 2500 w. Mun Eng—June, 1918. Address to S-W W-Wks. Assn. Its use and examples of successful applications.

Reconstruction

Methods Employed in Reconstructing Fort Madison, Ia., Water Works Plant on Exact Site of Old Plant Without Interrupting Operation (86679 A). Ills. 1800 w. Mun Eng—June, 1918. Details of the work.

Reservoirs

Some Design Features of the Waban Hill Covered Reservoir of the Newton, Mass., Water Works (86678 A). Edwin H. Rogers. 1000 w. Mun Eng—June, 1918. Design of new sections in the extension of the covered reservoir.

Silting

Carriage of Alluvium by Water Courses (86602). Felix Drouhet, in *Le Genie Civil.* [illegible] w. Eng & Con—May 29, 1918. Method of preventing the silting up of storage reservoirs.

Stave Pipe

The Possibilities of Creosoted Douglas Fir Wood Stave Pipe for Use in Irrigation and Water Supply Systems (86[illegible] A). O. P. M. Goss. Ills. 1000 w. Wood Presg—April-June, 1918. Serial, [illegible]. Results of tests.

WATERWAYS AND HARBORS

Canals

New Canal of Trollhattan at Goteborg, Sweden (86607). From *Le Genie Civil.* 1800 w. Eng & Con—May 29, 1918. General features of the work.

Will the Proposed Lake Erie and Ohio River Canal If Built Be An Economic Success? (86837 B). W. G. Wilkins, with discussion. Maps. 57 pp. Engrs Soc W Penn—March, 1918. Conclusions unfavorable to the project.

Dry Docks

Champlain Dry Dock, Quebec (86960). Ulric Valiquet. Ills. 4500 w. Can Engr—June 13, 1918. Read before Can. Soc. of Civ. Engrs. Detailed description of its construction.

France

Les Agrandissements Des Ports De La Basse-Loire (87122 B). A. Breton. Ills. 1000 w. La Nature—Apr. 27, 1918. Development of Nantes and Saint-Nazaire due to recent improvements in the Loire river near its mouth.

Les Agrandissements Du Port De Bordeaux (87128 B). A. Breton. Ills. 1100 w. La Nature—May 18, 1918. Enlargement of the docks and harbor.

Les Ports Français Durant La Guerre (87139 B). A. Pawlowski. Ills. 6400 w. Génie Civil—May 25, 1918. Serial, 1st part. French Ports during the war —I. Bizerte and Tunis. Natural advantages, docks and harbor facilities.

Projects for the Development of the Port of Havre (86603). From *Le Genie Civil.* Ills. 2500 w. Eng & Con—May 29, 1918. Former conditions and the new programme of improvement.

Conditions at French Ports During the War (86609). Auguste Pawlowski, in *Le Genie Civil.* 2000 w. Eng & Con —May 29, 1918. War measures described.

Continental River Ports of France and Germany (86605). M. Jacquinot, in *Le Genie Civil.* Ills. 2500 w. Eng & Con—May 29, 1918. Deals particularly with interior and exterior river ports, the transportation for manufactories, unloading and storage, etc.

Italy

L'Opera Dell' Ufficio Idrografico Del Po (87104 B). 4900 w. Monitore Tecnico—Mar. 20, 1918. Improvement works on the River Po.. Rainfall data, flow, suspended matter, etc.

Zeebrugge

L'Embouteillage Des Entrées Des Ports D'Ostende et de Zeebrugge (87132 B). A. Poidlone. Ills. 4000 w. Génie Civil—May 4, 1918. Closing of the harbor entrance to Zeebrugge and Ostend by the British raid.

MISCELLANY

War

The United States and the Far East (87086 N). A. Gerard. Translated from *Revue des Deux Mondes.* 16 pp. Roy Un Serv Instn, Jl—May, 1918. Examines the rôle of the United States in the Far East.

MARINE AND NAVAL ENGINEERING

Balancing

Notes on the Subject of Balancing (86928 F). N. W. Akimoff. 11 pp. Am Soc Nav Engrs, Jl—May, 1918. Reply to Commander Cleary's article on "Dynamic Balancing."

Bolts

Stress Distribution in Bolts and Nuts (86583 N). C. E. Stromeyer. Ills. 5000 w. [illegible]—May [illegible], 1918. Elementary principles discussed, giving results of investigations

Cargo Ships

On the Design and Construction of Reinforced Concrete Cargo Steamers. Now Building (86585 N). T. G. Owens Thurston. Ills. 12 pp. Instn Nav Archts —Mar. 23, 1918. Details.

To avoid error, please order by title and number only.

Standard Cargo Ships (86579 N). George Carter. Ills. 5000 w. Instn Nav Archts—Mar. 20, 1918. Advantages of standardization in the construction of large cargo vessels as a war measure.

The Most Suitable Sizes and Speeds for General Cargo Steamers (86580 N). John Anderson. Ills. 4000 w. Instn Nav Archts—Mar. 20, 1918. Aims to formulate a method by which the most economical dimensions can be arrived at, for any length of voyage, condition of loading, or speed.

Concrete Ships

Concrete Ships (87149). E. O. Williams. 2000 w. Times Engng Supp—May, 1918. Advantages and defects of such construction.

Navi In Cemento Armato (87100 C + D). F. Dondona. Ills. 8000 w. Rivista Marittima—Jan.-Feb., 1918. Design and construction of reinforced concrete vessels, particularly those built in France and in Scandinavian countries. Arrangement of ways, etc.

Construction of Reinforced Concrete Ships by Hennebique and Marelle Systems (86601). G. Espitallier, in *Le Genie Civil.* Ills. 1800 w. Eng & Con—May 29, 1918. Details of these two French systems.

Observation on Ferro-Concrete Ships (87060). Joseph R. Oldham. 1200 w. Naut Gaz—June 22, 1918. Critical discussion of these vessels and their equipment.

Progress in the Application of Concrete to Barge and Shipbuilding (86878 A). J. E. Freeman. 17 pp. Utah Soc Engrs, Mthly Jl—April, 1918. Information concerning the construction and design, reviewing progress and the problems.

Design

A System for the Design of Ships with Straight-Lined Sections (86688 A). C. W. Bion. Ills. 1200 w. Int Mar Eng—June, 1918. New method proposed.

Dry Docks

Floating Dry Docks of Concrete (86641). Anton S. Rosing. Ills. 1500 w. Naut Gaz—June 1, 1918. Abstract of article in *Bul. of Norwegian-American Chamber of Commerce.* Describes construction in Norway.

Explosion Effects

Committee Appointed by the Council to Inquire Into the Effects of Explosions of Mines and Torpedoes on the Structure of Merchant Ships (86578 N). 1200 w. Instn Nav Archts—1917. Reports on cargo ships and existing large mail and passenger vessels. Suggestions for certain temporary war expedients.

Ljungström System

The Turbo-Electric Ship Wulsty Castle (86722 A). Ills. 2500 w. Engr—May 17, 1918. The first ocean-going vessel built in England on the Ljungström turbo-electric system.

Electric Marine Propulsion (87148). 1000 w. Times Engng Supp—May, 1918. Ljungström turbines. Opinions of British designers.

Naval Engineering

A Fifty Year Retrospect of Naval Marine Engineering (86927 F). C. W. Dyson. 47 pp. Am Soc Nav Engrs, Jl—May, 1918.

Safety

Scientific Signalling and Safety at Sea (86708 A). Ills. 4000 w. Engng—May 17, 1918. Abstract of Prof. John Joly's lectures at the Royal Institution. Suggestions for increasing safety at sea.

Salvage

Post-War Salvage of Merchant Ships (87061). From *Liverpool Jl. of Commerce.* 1500 w. Naut Gaz—June 22, 1918. Discusses methods of raising torpedoed vessels.

Salvage of the German Tanker Gut Heil (86689 A). Robert G. Skerrett. Ills. 1500 w. Int Mar Eng—June, 1918. Compressed air raises 6000-ton vessel after lying five years on bed of Mississippi River.

Screw Propellers

Screw Propeller Manufacture (86930 F). U. T. Holmes. 1800 w. Am Soc Nav Engrs, Jl—May, 1918. Methods employed at one of the leading shipyards.

Shipbuilding

The Shipyard Task (87152). 1400 w. Times Engng Supp—May, 1918. The United Kingdom's tonnage problem. Rate of construction, losses by U boats, etc.

Federal Ships Erected by Derrick Travelers Built for Long Service (86874). Ills. 1500 w. Eng News-Rec—June 13, 1918. Problems of the erection of the 9600-ton steel ships.

Present Practice in Building and Launching Ships (86802). F. J. French. 1500 w. West Eng—June, 1918. Methods of building and comparative merits of launching stern-foremost and sideways.

Hurley Denounces Germany (86845). Address at South Bend, Ind. 5500 w. Naut Gaz—June 15, 1918. Outlines the growth of our merchant marine.

Tower Derricks Serve Twin Shipways at Submarine Boat Corporation Yard (86693). Ills. 2000 w. Eng News-Rec—June 6, 1918. Features of the building-berth layout at Newark Bay.

Shipping

New Shipping Legislation (86642). 1800 w. Naut Gaz—June 1, 1918. Details of proposed laws extending the President's powers over our merchant marine.

Ship Protection

Bescherming van koopvaardijschepen tegen automobiele torpedo's (87109 B). J. K. E. Triebart. Ills. 1900 w. Ingenieur—Mar. 30, 1918. Protection of merchant ships against torpedoes.

Ship Stresses

An Investigation of the Shearing Force and Bending Moment Acting on the Structure of a Ship, Including Dynamic Effects (86584 N). A. M. Robb. Ills. 12 pp. Instn Nav Archts—Mar. 22, 1918. Outlines investigations of a vessel of the intermediate, cargo and passenger type.

Shipyards

Hydraulic Equipment of a Modern Shipyard (86599). J. H. Rodgers. Ills. 2500 w. Mar Eng, Can—May, 1918. Modern practice in a fully equipped plant.

Stability

The Effect of the Longitudinal Motion of a Ship on its Statical Transverse Stability (86581 N). G. S. Baker and Miss E. M. Keary. Ills. 2500 w. Instn Nav Archts—Mar. 21, 1918. Experimental investigations and results.

Steam Traps

Steam Traps in the Naval Service (86926 F). F. G. Hechler. Ills. 15 pp. Am Soc Nav Engrs, Jl—May, 1918. Classification, operation, capacity, types, etc.

Storage Batteries

Sull' Impiego Degli Accumulatori (87101 C + D). G. Ferretti. Ills. 2800 w. Rivista Marittima—Jan.-Feb., 1918. Methods of charging storage batteries on submarines. Calculation of generating sets, etc.

Submarines

Le Navi Ausiliarie Sommergibili Nelle Marine Da Guerra (87107 B). C. Zecchini. Ills. 3300 w. Industria—Apr. 30, 1918. Design for a cargo carrying submarine.

Training

Training Shipyard Workers by Emergency Fleet Corporation Methods (86687 A). R. V. Rickcord. Ills. 2500 w. Int Mar Eng—June, 1918. Carefully selected mechanics taught by skilled instructors.

Manning the New Merchant Marine (86587 A). Henry Howard. Ills. 3000 w. Mar Rev—June, 1918. How the U. S. Shipping Board is training officers and crews for the new American ships.

MINING AND METALLURGY

BASE METALLURGY

Copper

Determining Copper Minerals in Partly Oxidized Ores (86901 A). Felix Cremer. 3000 w. Met & Chem Eng—June 15, 1918. Comparative merits of the various methods. The important effects of grinding and of iron are also discussed.

Slag

Matte-Settlement and Slag-Disposal at Grand Forks (86954). Walter B. Bishop. Ills. 2500 w. Min & Sci Pr—June 15, 1918. Methods used and details of operation.

COAL AND COKE

Benzol

Benzol Rectification (86702 A). T. D. Hamer. 4000 w. Colly Gdn—May 3, 1918. Latest developments in the continuous debenzolizing apparatus, giving actual results selected for periods of one month.

British Coal

Britain's Coal Trade Since 1914 (86846). M. K. Moorehead. 2500 w. Naut Gaz—June 15, 1918. Reports decline in production and loss of foreign markets among other effects of the world war.

By-Products

By-Product Coke Industry in War Time (86844 A). William Hutton Blauvelt. Read before Am. Ir. & St. Inst. 1500 w. Iron Age—June 13, 1918. Importance of fuel conservation; raw materials for high explosives a vital matter.

Coal Problems

Some of the Coal Producer's Problems (86793). D. H. McDougall. 1500 w. Can Min Jl—June 1, 1918. Presidential address before Min. Soc. of Nova Scotia. Supply and transportation, value, use, price and production.

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Coke

Raising Steam From Coke (87145). 1100 w. Times Engng Supp—May, 1918. Use of mechanical stokers for coke firing.

The Importance of Coke Hardness (86706 A). G. D. Cochrane. From paper read before Iron & Steel Inst. 1200 w. Colly Gdn—May 3, 1918. Effect of hardness on coke consumption.

Coke Loading

Loading Door for Coke Ramps (86772 A). H. Hermanns, in Gluckauf. Ills. 800 w. Colly Gdn—May 10, 1918. Detailed description of a new type of door.

Coke Ovens

By-Product Coke Oven Installation on Tess-Side (86719 A). Ills. 1200 w. Engr—May 10, 1918. Installation at Thornaby iron-works described.

Rock Salt in Coke Oven Saturators (86704 A). G. A. Phillipson, with discussion. 2000 w. Colly Gdn—May 3, 1918. Some reasons for the formation of rock salt in saturators.

Fuel-Saving

Vigorous Fuel-Saving Campaign (87062). 2000 w. Elec Wld—June 22, 1918. Critical conditions of coal supply for next winter led to organized plans for economy in New England.

Instruments

Some Useful Instruments for Colliery Power Plants (87083 N). H. W. Ravenshaw, with discussion. Ills. 17 pp. Instn Min Engrs, Trans—May, 1918. Describes instruments not widely known.

Mine Roofs

Some Notes on Roof Conditions at the Lethbridge Colliery (86906 N). J. B. De Hart. Ills. 1200 w. Can Min Inst, Bul—June, 1918. Explains behavior of the roof.

Outbursts

An Instantaneous Outburst of Coal and Gas (86774 A). F. N. Siddall. 2000 w. Colly Gdn—May 17, 1918. An account of an occurrence in Lancashire, and of similar outbursts.

Pillars

The Extraction of Coal Pillars from "Fiery" Seams, and Goaf Stowing in Indian Mines (86945 N). R. H. Husband. Ills. 20 pp. Min & Geol Inst of India, Trans—Jan., 1918. Details of system recommended.

Powdered Coal

See Fuels under MECHANICAL ENGINEERING, *Steam Engineering*.

Quality

Limiting the Impurities in Coal (86841 A). 4000 w. Iron Age—June 13, 1918. Discussions at meeting of A. S. M. E. at Worcester, Mass. Government plans to govern quality and curtail supply.

Stone Dusting

Stone Dusting in Mines (86773 A). A. Rushton. 1200 w. Colly Gdn—May 17, 1918. Describes a sprayer and its operation, which gives a better deposit and better mixing.

Storage

The Safe Storage of Coal (86832 A). W. D. Langtry and J. F. Kohout, in *The Black Diamond*. 2500 w. Coll Gdn—May 24, 1918. Precautions when storing in open piles.

Unloading

American Methods of Unloading Coal from Car and Barge (86831 A). Ills. 4500 w. Colly Gdn—May 24, 1918. Arrangements for the receipt of coal from the railroad or ship.

GEOLOGY

Coal Seams

Preliminary Note on the Burning of Coal Seams at the Outcrop (86946 N). L. Leigh Fermor, with discussion. 13 pp. Min & Geol Inst of India, Trans—Jan., 1918. A study distinguishing between burning of coal seams at the outcrop, and the coking of coal seams in depth caused by intrusions of mica-peridotite.

Diamonds

The Formation of Diamond (86715 A). Charles Parsons. 2800 w. Engr—May 3, 1918. Serial, 1st part. May lecture at the Inst. of Metals. Reviews researches and investigations to account for the origin.

Molybdenite

A Pegmatitic Origin for Molybdenite Ores (86869 B). E. Thomson. Ills. 11 pp. Ec Geol—June, 1918. Investigations of molybdenite properties in Quebec and Ontario.

Oil Fields

Geology of the Oil Fields of North Central Texas (86913 D). Dorsey Hager. Ills. 10 pp. A I M E, Bul—June, 1918. Describes the general geology, and gives statements as to probable prospective pools.

Ontario

Onaping Map-Area (86806 N). W. H. Collins. Maps & Ills. 147 pp. Can Dept Mines—Geol Surv, Mem 95. General character of the area, the geology, ore deposits, properties developed, etc.

Ore Deposits

The Geology and Ore Deposits of Ely, Nevada (87173). Abstract of paper by Arthur C. Spencer. 3000 w. Min & Sci Pr—June 22, 1918. Description and origin of copper ore and other deposits.

Quebec

Contributions to the Mineralogy of Black Lake Area, Quebec (86808 N). Eugene Poitevin and R. P. D. Graham. Ills. 103 pp. Can Dept Mines, Museum Bul, No. 27—Feb. 28, 1918. Geology, minerals, their mode and origin, etc.

Timiskaming County, Quebec (86807 N). M. E. Wilson. Maps & Ills. 187 pp. Can Dept Mines—Geol Surv, Mem. 103. Results of several years of geological work in northwest Quebec. General description, physiography, etc.

Sulphides

The Relation of Sulphides to Water Level in Mexico (86912 D). P. K. Lucke. Ills. 900 w. A I M E, Bul—June, 1918. Demonstrates that carbonates of ores may occur below water level and sulphides above, explaining causes of the phenomena.

Utah

Notes on Gold Hill and Vicinity, Tooele County, Western Utah (86867 B). J. F. Kemp and Paul Billingsley. Ills. 27 pp. Ec-Geol—June, 1918. The geology, mines, ore bodies, etc.

IRON AND STEEL

Blast Furnaces

Blast-Furnace Bears (86727 A). J. E. Stead. Ills. 7500 w. Ir & Cl Trds Rev—May 3, 1918. Abstract of paper before Iron & Steel Inst. A study of the characteristics, structure, etc.

Blast Furnace Working (87154). 2500 w. Times Engng Supp—May, 1918. Report to Iron & Steel Inst. by special committee.

Fuel Economy in Blast Furnaces (86728 A). T. C. Hutchinson. Ills. 2800 w. Ir & Cl Trds Rev—May 3, 1918. Conditions that secure long life of furnace lining and the resulting fuel economy.

Efficiency

Iron Works Efficiency: Some Engineering Features (86810 N). Frank Anslow, with discussion and correspondence. Ills. 42 pp. West Scot I & S Inst, Jl—Jan.-Feb., 1918. Reviews developments, problems to be solved, the outlook, etc.

Le Service D'Économie De Combustible (87114 C + D). T. Laurent. Ills. 4300 w. Revue De Métallurgie—Mar.-Apr., 1918. Attainment of fuel economy through scientific methods at important French foundry and steel works.

Electric Steel

Triplex Process of Making Electric Steel (86733 A). Theodore W. Robinson, with discussions. Ills. 4500 w. Iron Age—June 6, 1918. Past and present outlook and future estimate.

Development of Electric Cast-steel Anchor Chain (86764 A). W. L. Merrill. Ills. 1800 w. Gen Elec Rev—June, 1918. An economical method of greatly increasing the production of stud-link anchor chain.

Ingots

Defects in Steel Ingots (86729 A). J. N. Kilby. Ills. 5000 w. Ir & Cl Trds Rev—May 3, 1918. Observations and results.

Iron Ore

Iron Ore Report of Advisory Council Department of Scientific and Industrial Research (87069). Map. 9000 w. Eng & Min Jl—June 22, 1918. Summary of a report on the iron-ore situation today, with a synopsis of other metals used in making steel products.

Liquid Steel

The Determination of the Temperature of Liquid Steel Under Industrial Conditions (86716 A). Cosmo Johns. Faraday Society-Conference on pyrometry. 2500 w. Engr—May 3, 1918. Trained observers using a correct type of pyrometer can obtain readings of sufficient accuracy to secure effective control of the process.

Manganese

Manganese Conservation in Steel Making (86734 A). C. R. Ellicott, with discussions. 4500 w. Iron Age—June 6, 1918. National requirements and supply.

Manganese at Butte, Montana (86943). Excerpt from Bul. 690-E, U. S. Geol. Survey. 4000 w. Eng & Min Jl—June 15, 1918. Composition and types of manganese ores, with estimates of the quantity.

Overstrain

Overstrain and Fatigue Failure of Steel as Related to Grain Structure (86695). Henry S. Prichard. Ills. 4000 w. Eng News-Rec—June 6, 1918. Microstructure furnishes explanation of mechanical phenomena.

Pearlite

The Effect of Cold-Work on the Divorce of Pearlite (86711 A). J. H. Whiteley. Read before the Iron & Steel Inst. Ills. 3000 w. Engng—May 17, 1918. A record of observations made in a study of the Eggertz color test for combined carbon. Shows that the effect of cold-work is to produce an alteration in the degree of electrochemical action between the ferrite and cementite while the sample is dissolving.

Phosphorus

Effect of Phosphorus on Soft Steels (86842 A). J. S. Unger. Ills. Abstract of paper before the Iron & Steel Inst. 1800 w. Iron Age—June 13, 1918. Only increased hardness caused in acid and basic open-hearth steels by high phosphorus content; higher tensile strength.

Steel

Addendum to the Report of Committee A-1 on Steel (87033 N). 11 pp. Am Soc Test Mat—June, 1918. Reports of three sub-committees.

British Automobile Steels (86769 A). Ills. 2500 w. Autocar—May 18, 1918. Lack of uniform quality and heat treatment charged.

Changes Within the Critical Range of a Given Steel: From Ac 1 to Ac 3-2 (87035 N). J. G. Ayers, Jr. Ills. 10 pp. Am Soc Test Mat—June, 1918. Describes the most important metallographic changes in the critical range of steels.

Non-Metallic Inclusions: Their Constitution and Occurrence in Steel (86730 A). Andrew McCance. Abstract of paper before Iron & Steel Inst. 4500 w. Ir & Cl Trds Rev—May 3, 1918. Their composition and how to avoid them.

Note on Inclusions in Steel and Ferrite Lines (86710 A). J. E. Stead. Ills. 1700 w. Engng—May 17, 1918. Read before the Iron & Steel Inst. Experiments to determine whether or not nonmetallic inclusions in steel induce ferrite to crystallize around them.

MINE OPERATION

Caved Stopes

Recovering Caved Stopes in Narrow Veins (86942). Claude T. Rice. Ills. 6000 w. Eng & Min Jl—June 15, 1918. Serial, 1st part. Causes and effects of stope caving with special regard to the Coeur d'Alene mines, and methods to recover stopes.

Comstock Lode

Mining Lower Levels of the Comstock Lode (86744). Lewis H. Eddy. Ills. 2200 w. Eng & Min Jl—June 8, 1918. Reviews conditions at Virginia City, Nev. Completion of drainage facilities and development of ore bodies.

Mine Air

The Estimation of Injurious Dust in Mine Air by the Kotzé Konimeter (86712 N). John Innes, with discussion. Plates. 11 pp. Chem, Met, & Min Soc of S Af—March, 1918. Advantages over other methods of dust sampling, giving results of experiments and experience.

Mine Fires

Engineering Problems During Mine Fire at Utah-Apex Mine, Bingham Canyon, Utah (86911 D). V. S. Rood and J. A. Norden. Ills. 11 pp. A I M E, Bul—June, 1918. Conditions before the fire, during the fire, and afterward.

Mining Law

New Mining Law of Portugal (87174). George Warren Tower, Jr. 1200 w. Min & Sci Pr—June 22, 1918. The law is substantially that of a leasing system.

Safety Lamps

Approved Safety Lamps (86703 A). Ills. 4000 w. Colly Gdn—May 3, 1918. Gives the safety lamps order of the 9th of March, 1918.

MINES AND DISTRICTS

Alsace-Lorraine

La Valeur Économique De L'Alsace-Lorraine (87123 B). L. De Launay. 4500 w. La Nature—May 4, 1918. Economic importance of Alsace-Lorraine; its coal and iron industry; oil and potash; textile mills, etc.

California

The Calico District, California (86633). Leroy A. Palmer. 3000 w. Ills. Min & Sci Pr—June 1, 1918. An abandoned district, formerly famous for its silver; deposits of borate; silver possibilities.

Copper River

Mining in the Lower Copper River Basin (86791). F. H. Moffit. Maps. 3500 w. Min & Sci Pr—June 8, 1918. Abstract from Bul 662-C. U. S. Geol. Surv. Deals with Kennecott-Bonanza, Jumbo, and Erie mines.

Death Valley

The Sink of the Amargosa (86643). George J. Young. Ills. 1200 w. Eng & Min Jl—June 1, 1918. Death Valley described. The saline deposits.

Rand

Presidential Address (86809 N). Hugh F. Marriott. 21 pp. Instn Min & Met, Bul 163—April 25, 1918. Points in the history of the Rand not found in other records.

South Africa

Mineral Production of South Africa in 1917 (86746). A. Cooper Key. 1500 w. Eng & Min Jl—June 8, 1918. Effects of war conditions. Profits in general decreased.

MINOR MINERALS

Antimony

Antimony in 1916 (87080). Edson S. Bastin. 6 pp. U S Geol Surv, I:22—June 14, 1918. Sources, uses, production, imports, prices, etc.

Fluorspar

Fluorspar Mining in Ontario (87040). Ills. 800 w. Can Min Jl—June 15, 1918. Properties near Madoc, Ontario.

Kelp

The California Kelp Operations of the Hercules Powder Company (86655 A). Ills. 2200 w. Met & Chem Eng—June 1, 1918. An American industry developed as a result of a demand for acetone for use in munitions.

Nickel

Nickel Industry of Canada (86836 N). 2500 w. Imp Inst, Bul—Oct.-Dec., 1917. Information from the latest report of the Royal Ontario Nickel Commission.

Nitrates

The Advent of Modern Mill Mechanism to Nitrate Leaching (86644). Donald F. Irvin. Ills. 3500 w. Eng & Min Jl—June 1, 1918. The nitrate in Chile, with respect to the leaching of nitrates, by use of more advanced practice.

Potash

Production of Potash in United States (87025). William B. Hicks. 3000 w. Mfrs Rec—June 20, 1918. Revised paper presented at Pittsburgh meeting of Am. Assn. for Adv. of Sci., Dec. 31, 1917. Development of industry; possibility of increased production.

Tungsten

Tungsten Ore Deposits Near Falcon Lake, Man. (86794). Justin S. De Lury. Ills. 1800 w. Can Min Jl—June 1, 1918. The ores and their occurrence.

The Metallography of Tungsten (86910 D). Zay Jeffries. Ills. 56 pp. A I M E, Bul—June, 1918. Notes on the manufacture and metallography of wrought and ductile tungsten, and the general relationship between the properties of tungsten and other metals.

OIL AND GAS

Fuel Oil

Fuel Oil Supply (87144). 1600 w. Times Engng Supp—May, 1918. Oil obtained by distillation from cannel coal at gas works.

Gasoline

Recovery of Gasoline from Natural Gas by Compression and Refrigeration (87081 A). W. P. Dykema. Ills. 117 pp. U S Bur Mines—Bul. 151. Treats of this process from viewpoint of practical engineer and business man.

Inflammable Gas

The Estimation of Methane in Surface Strata (87076 A). C. D. Mottram. 1700 w. Colly Gdn—May 31, 1918. Work undertaken to determine whether any inflammable gas was rising from the surface of certain fields.

Oil Fields

Cementation in the Illinois Oil Field (86944). M. L. Nebel. Ills. 2500 w. Eng & Min Jl—June 15, 1918. Exclusion of water from oil wells in drilling.

The Geologist and the Development of Our Oil Fields (86905 N). M. Y. Williams. Maps. 3000 w. Can Min Inst, Bul—June, 1918. Deals particularly with work in Canada.

The Significance of Certain Mexican Oil Field Temperatures (86868 B). E. De Golyer. 27 pp. Ec Geol—June, 1918. Methods of temperature measurements; general geologic conditions.

Oil Shales

The Economic Position of Oil Shales (86659 A). Jac. C. Morrell and Gustav Egloff. 7000 w. Met & Chem Eng—June 1, 1918. Economic distribution, methods of production, yields, etc.

Petroleum

Chemistry in the Petroleum Industry (86765 B). William M. Burton.. Address at the awarding of the Willard Gibbs medal. 3500 w. Jl Ind & Eng Chem—June, 1918. Outlines the work of the chemist in the refining of petroleum and the distillation of the various products.

Bibliography of Petroleum and Allied Substances, 1915 (86816). E. H. Burroughs. 125 pp. U S Bur Mines—Bul. 149. Index to petroleum literature of the year.

Reservoirs

Système De Flotteur Réduisant Les Pertes Par Évaporation (87135 B). A. Grebel. Ills. 4000 w. Génie Civil—May 11, 1918. Gaging system to reduce losses of volatile liquids by evaporation.

Shale Oil

Commercial Aspects of the Shale-Oil Industry (86798). J. H. G. Wolf. 2000 w. West Eng—June, 1918. Requirements for a successful plant.

ORF DRESSING

Flotation

Molecular Forces and Flotation (86632). Will H. Coghill, with editorial. Ills. 4000 w. Min & Sci Pr—June 1, 1918. Principles of the drop-weight method for surface tension.

On the Molecular Physics of Ore Flotation (86658 A). Will H. Coghill and C. O. Anderson. Ills. 3500 w. Met & Chem Eng—June 1, 1918. Underlying principles involved in calculating the flotability of solids.

Tube-Milling

Artificial Pebbles for Tube-Milling (86745). A. W. Allen. Ills. 7800 w. Eng & Min Jl—June 8, 1918. Use of flint pebbles in tube-mills and the substitution of other hard stones and rocks for the imported flints.

PRECIOUS METALLURGY

Gold

The Matachewan Gold Area (87039). A. G. Burrows. 3000 w. Can Min Jl—June 15, 1918. Extracts from recent report on this Ontario field.

Precipitation

Charcoal Precipitation of Auro-cyanide (86900 A). A. W. Allen. Ills. 1800 w. Met & Chem Eng—June 15, 1918. The new Moore-Edwards process, with discussion of the underlying theories.

MISCELLANY

Mineral Industry

The Mineral Industry After the War (86904 N). Alfred W. G. Wilson. 4000 w. Can Min Inst, Bul—June, 1918. A study of possible commercial development in Canada.

Minerals

The War-Minerals Bill (87274). 11 pp. Min & Sci Pr—June 29, 1918. Testimony given by Van H. Manning, Director of U. S. Bureau of Mines, before the Committee on Mines and Mining of the House of Representatives.

Mining Industry

The Mining Industry: The Keystone of Modern Civilization (86792). R. H. Stretch. Ills. 4500 w. Min & Sci Pr—June 8, 1918. Reviews the history and development, and the future possibilities.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Administration

Doings of the United States Railroad Administration (86631). 5000 w. Ry Age—May 31, 1918. Serial, 1st part. Bituminous coal prices; the federal managers; standardization of operating statistics.

Government Control

British Railway Labor, Wages, and Living Under Government Control (87010). 5000 w. Ry Rev—June 15, 1918. Summary of British railway experience from report of the railroad wage commission.

Synopsis of Mr. George A. Post's Address (86820 A). 2500 w. Ry & Loc Eng—June, 1918. Salient features of an address at meeting of the Railway Business Assn.

Italy

Risultati Finanziari Dell' Esercizio Delle Ferrovie Italiane Di Stato (87105 B). 5400 w. Monitore Tecnico—Mar. 30, 1918. Financial operating results of Italian State Railways. 1905-6 compared with 1915-16.

Swiss Railways

Results of the Operation of the Berne-Loetschberg-Simplon Railway (86613). From *Le Genie Civil.* 2000 w. Eng & Con—May 29, 1918. Report of trials, by M. L. Thorwan, of this single-phase electric line.

U. S. Railroads

Doings of the United States Railroad Administration (86738). 6000 w. Ry Age—June 7, 1918. Serial, 1st part. First appointments of federal managers. Shop labor troubles.

MOTIVE POWER AND EQUIPMENT

Air Brakes

Air Brake Convention Proceedings (86964 A). 6000 w. Ry Mech Engr—June, 1918. Papers dealing with prevention of break-in-twos and slack action in passenger trains.

Feed Valve Maintenance (86918). W. Clegg. Ills. 1800 w. Ry Rev—June 8, 1918. A system for keeping air brake feed valves in working condition.

Bolsters

Some Important Points in the Design of Box Bolsters (86839). Louis E. Endsley, with discussion. Ills. 25 pp. Pro St L Ry Cb—May 10, 1918. Analyzes stresses developed in different shaped box bolsters.

Cars

Rehabilitation and Maintenance of the Wooden Freight Car (86917). P. P. Barthelemy. 3000 w. Ry Rev—June 8, 1918. Approved methods of putting wooden freight cars in condition to yield the maximum service.

Electric Braking

Regenerative Electric Braking on the Locomotives of the C. M. & St. P. Ry. (86759 A). W. F. Coors. Ills. 4400 w. Gen Elec Rev—June, 1918. Explains principles, and action of trains using this feature under various conditions.

Regenerative Electric Braking on Locomotives of the C. M. & St. P. Ry. (87011). W. F. Coors. Ills. 3000 w. Ry Rev—June 15, 1918. Explains the principle and advantages.

Electrification

Electrification of New York Connecting Railroad (86737). Ills. 1800 w. Ry Age—June 7, 1918. Method of operation on this link between the Pennsylvania and New Haven systems.

Extension of Railway Electrification (86916). L. F. Wilson. Ills. 2500 w. Ry Rev—June 8, 1918. Discussion of electrification problems and economics, and sources of power other than water-power.

The Reasons for Steam Railroad Electrification (86849). Q. W. Hershey. Ills. 1200 w. Ry Age—June 14, 1918. Density of traffic and safety.

Firebox Design

Radiant Heat and Firebox Design (86818 A). Résumé of paper by J. T. Anthony, before the Cent. Ry. Cb. Ills. 2500 w. Ry Loc Eng—June, 1918. Illustrates the process of radiation, showing the bearing on design.

"Radiant Heat and Fire Box Design (86932 A). James T. Anthony. Ills. 28 pp. Cent Ry Cb, Pro—May 10, 1918. Some of the important points in design of fireboxes.

Fuel Association

The Fuel Association Convention (86971 A). 6000 w. Ry Mech Engr—June, 1918. Abstracts of papers on fuel economy.

Fuels

Anthracite Silt as a Locomotive Fuel (87009). Ills. 2000 w. Ry Rev—June 15, 1918. Experiments made with a mixture of anthracite silt, describing methods of its preparation.

Locomotives

Drafting Modern Locomotives (86967 A). H. W. Coddington. 1500 w. Ry Mech Engr—June, 1918. Serial, 1st part. Improvements effected by a study of draft conditions on Norfolk & Western 4-8-2 type engines.

Nuovi Locomotori Trifosi A Quattro Velocità Delle Ferrovie Dello Stato (87106 B). E. Bovone. Ills. 2600 w. Industria—Apr. 15, 1918. Electric locomotive for Italian railways with three-phase, A. C. motors, four speeds and connecting rod-countershaft drive.

Pacific Type 4-6-2, Built by the Philadelphia & Reading Railway (86822 A). Ills. 1200 w. Ry & Loc Eng—June, 1918. Engines built to handle heavy and fast passenger service.

Recent Advantages in Locomotive Efficiency, Paris, Lyons, & Mediterranean Ry. (87008). Charles R. King Ills. 1800 w. Ry Rev—June 15, 1918. Uses compound principle in conjunction with superheating.

Small Locomotives of Special Types ([illegible] A). Ills. [illegible] w. Engr—May 17, 1918. Serial, 1st part. Types built in England.

Standardization of Indian Railways' Locomotives (86848). E. C. Poultney. Ills. 2500 w. Ry Age—June 14, 1918. Developed by British Engineering Standards Committee for the Secretary of State for India.

Ten-Wheel Locomotives for the Central Railroad of New Jersey (86819 A). Ills. 900 w. Ry & Loc Eng—June, 1918. 4-6-0 type for fast freight service.

2-10-2 Type Locomotives for the U. P. (86965 A). Ills. 1200 w. Ry Mech Engr—June, 1918. Built for service on heavy grade division.

Mechanical Associations

The Past and Future of the Mechanical Associations (87168). William Schlafge. 2000 w. Ry Rev—June 22, 1918. Address to the annual convention of the Am. Ry. Master Mechanics' Assn. Favors nationalization of railways.

Signals

How Signals Can Increase Track Capacity (86740). C. C. Anthony. Ills. 3500 w. Ry Age—June 7, 1918. Explains means of increasing traffic on multiple tracks.

Why Signals Are Essential for Heavy Traffic (86940). C. C. Anthony. 3500 w. Ry Sig Engr—June, 1918. Analysis of results to be obtained by the proper application to lines.

Superheater Dampers

Installation and Maintenance of Superheater Dampers (87012). Ills. 1600 w. Ry Rev—June 15, 1918. Instructions for installing, adjusting and keeping in serviceable condition.

PERMANENT WAY AND BUILDINGS

Grades

Oregon-Washington Railway Separates Grades for Three Miles at Portland (86696). Ills. 2000 w. Eng News-Rec—June 6, 1918. Track depression is combined with elevation of street approaches.

Holland

De nieuwe stapelplaats der Staatspoorwegen aan de Zeehaven te Dordrecht (87110 B). F. Van V. De Coningh Ills. 6200 w. Ingenieur—Apr. 6, 1918. Woodworking shops and timber treating plants of Dutch State Railways at Dordrecht.

Improvements

Distribution of Additions and Betterments (86625). 3000 w. Ry Age—May 31, 1918. Analysis of expenditures to be made on improvements for forty-nine lines.

Narrow-Gage

Along the British Front by Light Railway ([illegible]). Robert K. Tomlin Jr. Ills. 2500 w. Eng News-Rec—June 13, 1918. Serial, 1st part. Impressions of a week's study of the narrow gage system.

Repair Shops

A Well Organized Repair Shop ([illegible] A). Ills. 6000 w. Ry Mech Engr—June, 1918. Study of methods of repairing locomotives on the N. Y. C. at West Albany.

To avoid error, please order by title and number only.

Expedite Locomotive Repairs (86970 A). George W. Armstrong. 2200 w. Ry Mech Engr—June, 1918. A well knit organization, and adequate tools and facilities are necessary.

Scrap

Conserve and Reclaim Material (86968 A). 1200 w. Ry Mech Engr—June, 1918. From a circular letter issued by C. H. Markham, to all railroads under his charge.

Shops

New Grand Trunk Car Shops at Port Huron (86630). Ills. 2000 w. Ry Age—May 31, 1918. Detailed description of plant where special attention was given to arrangement.

Switches

Low Voltage Switch Machines Facilitate Traffic (86628). G. S. Pflasterer. Ills. 1200 w. Ry Age—May 31, 1918. How electrically operated switches help train movements in mountain country.

Application of Low Voltage Switch Movements (86941). G. S. Pflasterer. Ills. 1500 w. Ry Sig Engr—June, 1918. In connection with the progress made in signaling in a period of ten years on the N., C. & St. L.

Terminals

Buffalo Division Engine Terminals, Lehigh Valley R. R. (87167). Ills. 2500 w. Ry Rev—June 22, 1918. Improvements introduced in modernizing engine house facilities.

Construction Program Is Developed for Union Station at St. Paul (87016). Ills. 1200 w. Eng News-Rec—June 20, 1918. Seven constructive stages for this immense work planned. Work to be finished in 1922.

New Shops and Engine Terminals, Buffalo, Rochester & Pittsburgh Ry. (87169). Ills. 1200 w. Ry Rev—June 22, 1918. Describes improvements and facilities for requirements of the road's large Mallet type engines.

Tie Tampers

A Description of, and the Efficiency of the Imperial Tie Tampers (87022 A). George W. Vaughan. Ills. 30 pp. N Y Rd Cb, Pro—May 17, 1918. A machine developed and in use on the New York Central.

Tool Room

The Railway Shop Tool Room (86969 A). M. H. Williams. Ills. 6000 w. Ry Mech Engr—June, 1918. An important department, its efficiency affecting the entire plant.

Track Circuits.

The Maximum Regulating Resistance and Maximum Shunt Resistance of Track Circuits (86713 A). W. J. Thorrowgood. Read before the Instn. of Ry. Sig. Engrs. 3500 w. Ry Engr—May, 1918. Serial, 1st part. Points of importance in designing or laying out a track circuit. Resistance of steel rails, bond wires, etc.

ROADS AND PROJECTS

Cape-to-Cairo

L'État Actuel Des Routes Du Cap Au Caire (87127 B). C. Rabot. Ills. 1800 w. La Nature—May 11, 1918. Present status of Cape-to-Cairo railway line.

Connecting Railroad

11,000-Volt Overhead on the New York Connecting Railroad (86638). Ills. 2000 w. Elec Ry Jl—June 1, 1918. Everything ready for electric operation. Details of telephone and telegraph conduit construction.

Rapid Work

Building a Seven-Mile Railroad in 32 Days' Time (86626). Ills. 1500 w. Ry Age—May 31, 1918. A short spur built in Tennessee for government service.

TRAFFIC

Express

Four Express Companies to Be Consolidated (86739). 6000 w. Ry Age—June 7, 1918. Combination of the four principal companies.

Rates

Le Relèvement Général Des Tarifs (87138 B). J. Trévières. 4800 w. Génie Civil—May 18, 1918. Revision of rates on French railways by legislative act of Mar. 31, 1918.

Higher Freight and Passenger Rates Ordered (86627). 5500 w. Ry Age—May 31, 1918. Freight rates increase 25 per cent. and passenger basis will be three cents per mile.

STREET AND ELECTRIC RAILWAYS

Agreements

Recent Settlement Agreements (86856 A). Harlow C. Clark. 11 pp. A E R A—May, 1918. Tracing the trend toward the "Cost of Service" theory in the readjustment of agreements.

Car Design

Street Railway Cars of New Design. General Description. Method of Analysis Applied. Impact Stresses (87082 A). S. G. George and E. W. Rettger. Ills. 3000 w. Corn C E—April, 1918. Designs covering passenger, freight, interurban, and city cars.

Equipment

Railway Equipment Maintenance (86857 A). J. S. Dean. 14 pp. A E R A—May, 1918. Methods in use by leading companies.

Freight

Freight by Electric Railways (86855 A). F. E. Wynne. 2500 w. A E R A—May, 1918. How it can be extended with the minimum of capital expenditure.

Freight Motive Power Equipment (86639). G. M. Woods. Ills. 1200 w. Elec Ry Jl—June 1, 1918. Present equipment is sufficient if freight haulage is confined to off-peak hours.

Montreal

Remodeling the Hochelaga (Montreal) Power Plant (86742). Ills. 2200 w. Elec Ry Jl—June 8, 1918. Reconstruction to provide increased capacity in the engine room, boiler room and in the control and distributing sections.

Motor Curves

Current and Power Curves Show Results to Be Expected of Motors (86883). C. W. Squier. 1500 w. Elec Ry Jl—June 15, 1918. How current and power input graphs are derived from the speed-time and motor characteristic curves.

Public Control

Service-at-Cost Offered to all Massachusetts Electric Railways (86743). 4000 w. Elec Ry Jl—June 8, 1918. Legislature enacts measures providing for public control of Bay State street railway and state directors of other roads accepting service-at-cost plan.

Railway Motors

Dipping and Baking Railway Motors Will Decrease Troubles (86887). J. V. Dobson. Ills. 2500 w. Elec Ry Jl—June 15, 1918. Describes the apparatus necessary and the precautions that should be taken.

Rapid Transit

Some Features of New York City's New Rapid Transit System (86853 B). Robert Ridgway. Ills. 9500 w. Bos Soc C E, Jl—May, 1918. General summary of the programme of rapid transit, with description of interesting features and details of construction and cost.

Rates

The Status of the Higher Fare (87255). Thomas Conway, Jr. 4000 w. Elec Ry Jl. Review of the movement to secure higher electric fares in the State of New York.

Records

Maintenance Records That Prove Invaluable (85942). 1500 w. Elec Ry Jl—Apr. 27, 1918. Methods of performance of equipment on the Memphis street railway. Tables and graphs show results.

Repairs

Keeping the Track Special Work in Repair (86884). R. C. Cram. 2500 w. Elec Ry Jl—June 15, 1918. The repair and renewal of special work.

"Skip Stop"

History of the "Skip Stop" (86854 A). Alexander Shapiro. 15 pp. A E R A—May, 1918. Serial, 1st part. Its various forms, methods of putting it into effect, etc. Economies and benefits.

Steel Supports

Virtues and Limitations of steel supports in Overhead Construction (86327). Charles R. Harte. Ills. 3000 w. Elec Ry Jl—May 18, 1918. Types of permanent poles are considered.

Street Railways

The United Railways (86269 A). C. E. Smith. 45 pp. E Cb St L, Jl—Mar.-Apr., 1918. Present street railway situation reviewed.

Subway Tracks

Distribute Subway Track Material by Motor Truck (86042). Ills. 1700 w. Eng News-Rec—May 2, 1918. Methods of track laying in 7th Ave. subway, N. Y. City.

Terminals

Strassbahn-Depot auf dem "Dreispitz" in Basel (86465 B). Ills. 1100 w. Schweizerische Bauzeitung—Apr. 6, 1918. New terminals and car barns for tramway in Basle, Switzerland.

Tools

Selecting and Caring for Hand Tools Used by War Department (86330). R. C. Cram. Ills. 5000 w. Elec Ry Jl—May 18, 1918. Suggestions for the care, repair and use of tools.

Track Paving

Track Allowance Paving (86196) Murray Alexander Stewart. Ills. 2500 w. Can Engr—May 9, 1918. Methods in Toronto. History of the development of foundation and surface work.

Underframes

How the Underframe Contributes to the Durability of the Car Body (86885). Norman Litchfield. Ills. 2200 w. Elec Ry Jl—June 15, 1918. Making cars shock and vibration proof.

INDUSTRIAL MANAGEMENT
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Graphic Production Control – I

Underlying and Basic Considerations

By C. E. Knoeppel

Throughout all of his professional work Mr. Knoeppel *has made an extensive use of graphs to present the facts needed for management control in industry in the most readily available and most useful form. From the results obtained in some fourteen representative plants he has prepared a series of articles on graphic production control of which this is the first. Every industrial executive will find them of unusual value and helpfulness.*

Mr. C. E. Knoeppel, *founder and president of the firm of C. E. Knoeppel & Co., Inc., consulting engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three firms of industrial engineers. This experience led to the founding of his present organization.*

WE HAVE spoken of the world cycles that have passed as the iron age, the steel age, or the electrical age. Certain it is that we have been passing through an age of *invention;* a period of discovering and harnessing the laws and products of nature. It is equally certain, if we analyze closely enough, that the coming age will be that of securing the fruits of invention, through the rapid and economical making of things, in other words, *the age of production.*

The reconstruction that is to come will force a development in the realm of production, both extensive and intensive. We will find a world of depleted treasuries; of ruined and devastated territories; of helpless and poverty stricken peoples; of crippled, blind and diseased men; of nations hungry for food necessities; of disorganization and confusion carried to the *n*th power.

To salvage and reconstruct will require immense quantities of raw and semi-finished materials, machinery and equipment, supplies, building materials, farm products, clothing, ships and many other elements which enter into the economic life of a nation, and which its manpower will have to use wisely and well.

> Today is a time of ruthless destruction, but before long the happy change will come and we will have a period of intense production. In no other way can the World be restored. But production cannot be speeded until it is controlled, and control can only come through a complete knowledge of all the surrounding facts. By graphics these facts can be presented in a form to permit the making of immediate, accurate decisions. Our hope of meeting the approaching demands on industry lies in "graphic production control."

The world will stop its work of destruction one of these days—a destruction never before equalled in the World's history, and will have to turn to the work of production, on a scale equally as intensive as that of the destruction, or there will be unnecessary delays, with their consequent by-products waste, inefficiency, poverty, industrial clash and general suffering.

To rebuild a world, for that is practically what it amounts to, will demand a universal speeding up of production through the use of every possible device that has been or can be developed.

To speed production it must first be controlled. It therefore follows that the thing most needed in the reconstruction to come, is the most efficient means for controlling production.

What will furnish the means?

A type of management that can be characterized as "graphical management," in which use is made of *graphics,* in controlling production, and through which we will secure as by-products, *organization, standardization and costs.*

In other words, our sincere conviction based on years of close study, is that the industrial world must and will come to what can be termed, the industrial keystone of

Graphic Production Control

What do we mean by graphics?

Of the five senses—sight, hearing, smell, taste and touch—there is only one that is most used, insofar as production in industry is concerned, *sight*. In planning, controlling and getting out production, we do not use the senses of smell or taste at all. Hearing is employed to some extent, as is touch, but their employment is of minor importance. The organ most used is the eye, the camera of the mind, which photographing all things within its vision, gives the brain or executive of the body, the basis for reasoning, formulating decisions and initiating action. In other words the chain is—eye, to brain, to action.

Consequently, anything which facilitates the work of the eye is worthy of consideration and adoption. The painting of the artist portrays the beauties of nature *for our eyes*. Would we do without the artist? The camera reproduces details, scenes and views that are worthy of our attention *for our eyes to see*. Would we do without the camera?

Graphical presentation in industry, pictures the essential happenings of the shop *for our eyes*, and is to production, what the artist and the camera are to us in other things. Can we do without graphics in the shop, if this comparison holds?

Why do accountants plot graphical curves of the figures they desire to make impressive? Why do magazines represent statistical data graphically? Why do people like to look at pictures rather than at figures? Why are maps and colored tacks used in recording sales information rather than card indexes? Why are modern army operations represented and controlled graphically rather than by figures and card indexes? Why have the drafting room and the blue print become such important features of the most modern manufacturing organizations?

Because of the superiority of graphical presentation over that of statistical compilation.

What is a graphical presentation?

Suppose in a shop we want 150 pieces of something, have received 85, machined 48 and assembled 22. Which of the presentations in Figure 1 is the clearer from the standpoint of a quick, comparative picture?

The usual factory production system is a more or less vast array of forms, figures, compilations and statistical compilations, which the foremen, department managers or executives must take, compare, analyze and then mentally visualize, before coming to a conclusion. The aim of graphics, is to take the essentials and so picture them as both to stimulate and render less of a task the mental processes necessary for forming conclusions.

In other words, the purpose of graphics in controlling production, is to picture the elements of shop operations, so as to consider relativeness (or comparisons), progress (or results) and exceptions (or differences), as an aid in quickly forming conclusions and making decisions that will govern actions looking toward efficient results. As a practical example, note Figure 2 herewith.

The outstanding features in favor of graphics, as against the usual methods of controlling shop production, are:

1. *Simplicity*, in that a graphic presentation can be readily understood and read by the average shop man, where a mass of figures becomes indigestible. A graphic board to a shop man is the same as a trading board to a broker.

2. *Comprehensiveness*, in that all the essentials pertaining to a department or product, are concentrated in a small space, enabling the eye to contemplate an entirety rather than a series of details. A graphic board or chart is the shop or department in miniature.

3. *Ease of operation*, in that clerical help can easily maintain the graphical methods, leaving the managers free to simply "look and reason."

4. *Vividness*, in that the exceptions stand out in such a manner as to become much more impressive than an assortment of figures which must be mentally compared and related.

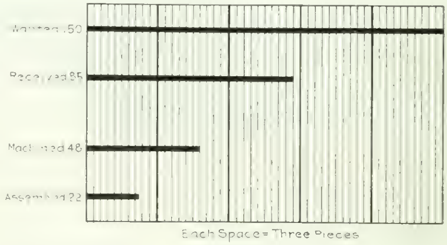


FIG. 1. COMPARISON OF STATISTICAL AND GRAPHIC METHODS OF PRESENTING PRODUCTION INFORMATION

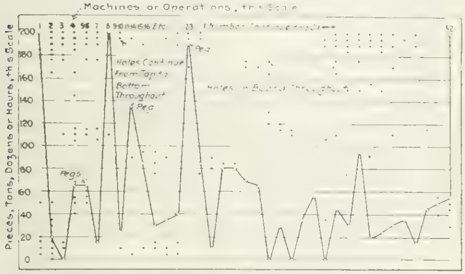
The most advanced doctrine of management is that the unit sold is really TIME—time of equipment; time of workmen; time money is tied up in materials; time of clerical help; time of storage in a given place; time to make tools and jigs; time to remove material from one place to another; time to set up machines; time of inspection. Any delays or enforced idleness at any of these points, spells waste or loss, resulting in high costs which makes for high prices. In proportion as manufacturers learn the costliness of idleness in industry in relation to the users of their products, in that same proportion will they welcome the efficacy of "graphic production control" to point out, unerringly, the *location* and *cause* of such idleness.

The commonest excuse met with in industry is, "I didn't know it in time." Machines may be out of repair, but why are they not kept in repair? Machines may be waiting for work, but why have not proper arrangements been made to keep jobs ahead for them? Operators may not be attending to machines properly, but where is the supervision? Machines may be waiting for set-up men, but why has not this been arranged for in advance? Machines may be waiting for tools, but why are not the tools on hand and in readiness for use? Machines may be waiting for material, but why have not the material requirements been anticipated? The reason these things happen, is because the facts are not made known soon enough to forestall trouble. If a man could be a mind reader and gifted with a sixth sense or second sight these things would be anticipated and provision made for efficient running, but not possessing these gifts, he has to resort to "I didn't know," which is usually true enough, but not the real reason. "Graphic production control" eliminates this excuse because it portrays *what is going to happen*, as well as what is happening. An average foreman knowing, hours in advance, that a machine is going to be down for work, or that tools will be needed, or that material will be needed or moved to the next operation, will see to it that action is secured, which will result in uninterrupted operation. *Graphic methods show these essential requirements well in advance.*

WHAT SHOULD GRAPHIC PRODUCTION CONTROL CONSIDER?

In the first place, while designed to indicate *progress* or what is actually happening, it should show *exceptions* or the things that may happen. Let us, therefore, consider the fundamentals in manufacturing in an effort to determine some of the things that graphics consider:

1. Detailed plans and instructions.
2. Raw materials.



NOTE { Pegs on which is string East [illegible] shows [illegible] ahead at any Time
Board changed continuously during Day. Faint Line Peg on Board indicates Danger Point.
Conclusions from Board — Operations 1, 8, 11 to 4, 23, 52 are very much Overloaded in that all below Faint Line requiring Work

FIG. 2. GRAPHICAL RECORD OF PROGRESS OF OPERATIONS

3. Labor.
4. Equipment and tools.
5. Supplies.
6. Assembling of parts.
7. Supervision.
8. Movement of material.

Lacking any one or more of these things and delay or congestion occurs. Let us consider possible reasons:

1. *Lacking detailed plans and instructions* may mean that there is no order; that the order is incomplete as to identifying the product to be made; that the order requires modificaion with insufficient explanation as to changes; doubt as to proper quanity to run through; lack of proper blueprints, sketches or dimensional details.

2. *Lack of raw material* may mean insufficient quantity; unsuitable quantity; inability to use material on hand because specified for other use; eleventh hour lack of material believed to be in stock; material which under normal conditions would have been received in time but delayed because of production or transportation troubles; error in quantity available according to inventory.

3. *Lack of labor* may mean temporary absence of the workman and inability to get substitutes; emergency absence through accident; voluntary absence as result of labor troubles; absence due to dissipation; inability to get the right kind of labor for the work in hand; inability to get labor owing to the plant growing faster than labor can be secured and trained.

4. *Lack of equipment and tools* may mean scarcity due to recent breakage; scarcity due to insufficient supply in stock; inability to provide necessary tools due to failure to anticipate peculiar requirements of the job; congestion at machines due to previous breakdown and consequent delay; congestion due to unnecessary use of desired equipment or tools, for products or operations which could have been handled on other equipment not now engaged; failure to make repairs promptly.

5. *Lack of supplies* may mean that material is out of stock; wrong kind of stock; inability to purchase the desired kind at the right moment; error in quanity on inventory.

6. *Lack of assembly work* may mean failure of stores department or preceding department to deliver material which was available; failure or foreman to assign workmen to the task; failure to secure the necessary supplies; failure to deliver instructions in advance of receipt of material.

7. *Lack of supervision* may mean too much clerical work by foremen; failure to appoint necessary subforemen; foremen's inability to watch current conditions because too much occupied in training new help or doing inspection work.

8. *Lack of proper material movement* may mean lack of move orders; congestion of material due to carelessness; lack of help; waiting for inspection.

Criticism without the suggestion of an improvement avails little. It is, therefore, necessary in studying production methods to distinguish between the virtues of the plant policies and methods and the merits due the workers' skill, experience and effort. So also must faults and oversights of the management be distinguished from the blunders and carelessness of the workmen. Faults and blunders in total are equal to those of the management plus those of the workmen. If then, facts as to priority, sequence, delays, errors, blunders, carelessness, oversights, can be made to appear in plain sight for the benefit of all concerned—by means of graphical control, we have a better means of showing this information concurrently than any other so far furnished, and one absolutely impartial and unbiased when it comes to a consideration of the merits of management and men. "Graphic production control" tells:

1. *As to the order.* What priority, if any, over its regular sequence? What standard or special order as to design, workmanship, material, ultimate purpose?

2. *As to the product.* Are designs and full instructions ready? Are all necessary materials in stock and ready? Has time of specific equipment been provided? Are all necessary tools known to be on hand and in good order? Is available labor ready and properly trained?

3. *As to progress?* Were all preceding operations finished on scheduled time? Will any preceding delay prevent starting current operations on scheduled time? Have recent operations of the sort been running under or beyond scheduled time?

4. *As to delays.* How are they caused—through insufficient instructions? lack of material or supplies? absence of worker? lack of tools? non-delivery of parts from preceding department? breakdown of equipment? error in processing by preceding department?

No general or introductory treatment of "graphic production control" would be complete without furnishing an outline, or specifications, of what the plan could be expected to show in the way of valuable information for the shop man to use in his work of getting out production. The following is submitted as an example of what a graphic method would indicate:

Relative importance of the various parts of an order from the standpoint of purchasing, processing and assembly.

Pieces received from the outside or from the foundry; pieces processed according to part of operation and the units assembled, at any given time.

Estimated times of the various operations; actual times against estimates (progressive) and the gains or losses in actual times over estimated times.

The costs of operations, as the work progresses.

Relation at any time between the actual progress of an order, in whole or in part, and the normal progress, indicating how far the actual progress is ahead or behind the normal progress.

Apportioning work to be done against equipment or departments, in such a way as to show congestion or excess capacity.

Performances of machines or operations against estimated production, showing gains or losses

Following up purchases.

Continuous inventory of material.

Inventory of labor, in hours, against machines and operations.

Manufacturing schedules showing dates work should start and finish with provision for showing progress.

Schedules for purchasing department, pattern shop, foundry and tool room.

How much work is ahead of any machine.

How much material is actually at any machine.

Sequence of jobs.

What job is on machine and, if there are others, the order of their importance.

What orders on any particular machine are held up for tools.

When tools are received.

When it is necessary to get more material to prevent breaking down a machine for a different job.

When material has arrived.

When it is necessary to get more orders to keep certain machines busy.

What machines are idle and for how long.

Whether machines are idle for: Breakdown, absent workman, workman on more important work, no work, waiting for tools or drawings, waiting for inspection, setting up, no power, waiting for crane.

When machine starts again after difficulty is remedied.

When machines have been repaired.

Control of material movement.

Control of inspection.

What machines are most congested.

Whether workmen is ahead or behind schedule.

If production is falling behind and where.

Whether orders are broken into more than necessary.

Time when an operation must begin.

Standard or estimated time set for doing work.

Actual time spent in doing work.

· When necessary to revise schedules to relieve congestion, or to meet conditions caused by absent workmen or breakdown.

Proper routing.

Where installation of additional equipment would be advisable.

Delay between operations.

Whether adequate supply of material is on hand.

Exact shop condition of any class of product or any order.

Comparisons of machines by departments.

Location of any order.

Completion percentage of any order.

Work released for next operation.

Standard hourly output of each machine.

Sequence of operations for any class of product.

Date a particular order will go to a machine.

Probable time of completing an order.

How many more operations are yet to be performed on an order.

Where to apply effort to secure an even flow of production.

GRAPHIC CONTROL IN WARFARE

In conclusion, let us turn for a moment from graphic control in industry to graphic control in warfare, in order that we may form some conception of what graphic control really means. In this connection the following newspaper dispatch is illuminating:

To be continued.

How General Joffre Runs His Army.—Dunkirk, October 28 (by mail): A man in pajamas (at least he wears them most of the time, being too busy to dress) is running the 1,001 details of the French army. General Joffre is at the head and he handles the big questions, presses the buttons, so to speak, but General Bertholet, Chief of Staff, does the actual work.

After several trips along the fringe of the war, after meeting thousands of soldiers on the same day, some going north, some going south, in what appeared to be a hopeless tangle, it struck me more forcibly than ever that the modern fighting machine is the most complicated thing on earth.

I tried to imagine myself commanding all this, to grasp how a 200-mile line of this sort could be controlled and how it could possibly be kept from getting tangled up with itself and without interference by an enemy. My curiosity grew, until I decided to find out how all this business is managed by one man.

In General Joffre's headquarters, in a certain long room, hangs a special map, the scale of which is 1/1000. It shows every road, canal, railway, bridle path, pigtrail, bridge, clump of trees, hill, mountain, valley, river, creek, rill and swamp. This is part of the outfit. Another part is a wonderful collection of wax-headed pins of all colors and sizes. These represent army units of all sizes and all organizations. Into the long run many wires, both telephone and telegraph. Wireless apparatus is also in this room. The way it works seems wonderfully simple when it is explained.

The battle is about to commence. The troops have been distributed all along the 200-mile line. The Germans are facing them. A bell rings: "Hello! Yes! The Germans are attacking General Durand's division? They are in superior numbers? The General needs reinforcements? All right."

The staff officer who has taken this information over the phone hurries to where General Bertholet is sleeping. The General has just dozed off. This is the first sleep he has had in thirty-six hours, but General Bertholet is wide-awake in an instant. He jumps to the floor, still wearing his pajamas, the only garment he has worn in several days. The staff officer reports.

In a twinkle, General Bertholet, who knows his map as he does his own face, locates Durand's division. He knows that ten miles back of Durand's command are quartered a number of reserves, under General Blanc, according to the pins. General Bertholet also learns from the pins that a number of autobuses are near General Blanc's soldiers.

"Order General Blanc," he commands, "to reinforcee Durand at once with 10,000 men, four batteries of 75-millimetre artillery, ten machine guns and three squadrons of cavalry. Tell Blanc to transport his troops in autobuses."

Within two minutes, General Blanc has received the order. Within five more he is executing it, and General Durand is informed that help is coming to him.

Then General Bertholet takes another nap, if the battle will permit. If it does not, he stays awake to direct men who are miles away from him.

Every time a bridge is blown up or a pontoon has been thrown across a stream of a food convoy shifts, General Bertholet gets up and shifts his pins to indicate the change. Nothing happens along the 200-mile battle line but that General Bertholet, still in pajamas, leaps from his bed and changes the pins on the map. The map must be kept up to the minute. Genera Joffre must be able to look at it any time of the day or night.

As far as possible, through information brought in by spies or aviators, the forces of the enemy are kept track of in the same manner. No detail that is of use is overlooked. The pins indicate even the size of the guns, the kind of ammunition they use, and so on *ad infinitum.*

If a war of such gigantic proportions can be conducted along such scientific lines; if something so full of the unforeseen can be controlled in the way outlined, *what is there to prevent the development of such methods as will give the industrial world the same efficient control of production?*

(To be continued.)

Prize for Paper on the Coördination of research in Works and Laboratories

The Council of the British Institution of Electrical Engineers are prepared to receive papers on the subject of "The Coördination of Research in Works and Laboratories," with a view to the paper being read and discussed at one of the Ordinary Meetings of the Institution in London and also before one or more of the Local Sections.

Papers should not exceed 15,000 to 20,000 words in length, and the Council are prepared to award a special premium of £25 to the author of the paper which in their judgment best fulfill the objects of the discussion, provided such paper reaches the standard aimed at by the Council.

Papers should be sent to the Secretary of the Institution not later than November 4th, 1918. It is the intention of the Council to publish the paper selected (which will become the property of the Institution) in tht *Journal* together with the discussion. Competitors intending to submit papers are invited to communicate with the Secretary.

Time Studies for Rate Setting on Gisholt Boring Mills—III

By Dwight V. Merrick

The two preceding installments of Mr. Merrick's *series have given detailed times for the operations of preparing a boring mill for the work of machining, and also detailed times for preparing the work to be machined. This installment takes up the actual manipulation of the machine for the cuts.*

Mr. Dwight V. Merrick *served a three years' machinist apprenticeship in the shop of the Southwark Foundry & Machine Company, going from there as a journeyman machinist to William Sellers & Company where he remained for one year. He then spent two years in the engineering course at Drexel Institute. At the completion of this studying he went back to the Southwark Foundry & Machine Company and served as a draftsman for three years, leaving in 1898 to go with Mr. Frederick W. Taylor at the Bethlehem Steel Company. In 1901 he left Bethlehem to go to the Link Belt Engineering Company, where he remained until 1911, devoting himself to the time study work. The following two years, 1911–1913, were spent in time study in the shops of the Watertown Arsenal. From 1913 to date Mr. Merrick has devoted himself to a consulting practice in time study, giving most of his efforts to the H. H. Franklin Manufacturing Company and in the manufacture or rifles, rifle ammunition and machine guns.*

Setting Tools in Post and Removing from Post

TURNING now to the tabulating time for tool setting we assume that the workman is at the operating position at the end of the rail at the beginning of each operation. He procures both the tool and the tool post wrench from the tool stand at the same time. The tables devoted to tool setting show the number and size of set screws that are to be tightened for the various tools in each of the several positions in which they may be used.

Ordinarily tools are used in the right-hand head of the machine. By right-hand head is meant the one which is at the right hand of the workman as he stands in front and facing the machine. The operations of setting tools in the left-hand head are identical with those for setting in the right-hand head. However the workman must traverse a greater distance in the latter case and additional time should be allowed.

Setting Rough Tools in Post

If roughing tools are used in both the right-hand and left-hand heads, Tables 25, 26, 29, and 30, no time as a rule should be allowed for the setting of the second roughing tool when preparing the instruction card. This second tool should be placed in the tool post after the machine has been started and after the first tool is actually engaged in removing metal. An exception to this practice may be permitted if considerations of safety require the workman to stop the machine while he is performing the operation "put tool in post and tighten set screw." In this event time should be allowed for stopping and starting the machine, but none for procuring the wrench and tool nor for removing the wrench to the stand after the second tool is set in place.

The operation item "obtain tool and wrench from stand" may be combined in the instruction card with the final element of the operation of squaring and levelling work, the workman removes his tools for that operation to the tool stand. In this event the time allowed on the instruction card for the final element of squaring and levelling, and for the unusual element for squaring the tool should be one half the sum of the times for these two operation items as given on the tables of the respective operations.

Unless parts are made in great quantities, the saving of time by eliminating a few elements from these fundamental operations is not good practice and so it would be better to build up fundamental operations from just such conditions if sufficient use would be made of them.

Setting Finishing Tools in Post

When seting square nose finishing tools the tool is placed in the tool post with its cutting edge against the work and two of the tool post screws are tightened lightly against it. The tool is then ratcheted back about 1/32 inch to provide clearance and the machine is starting to test the bearing of the tool on the work. If it is not set properly, it is adjusted by tapping it lightly while the machine is running, or by stopping the table and making a still greater adjustment. If the table has been stopped, it is then re-started and the tool again tested for bearing. If it is now found to be square with the work the tool-post set screws are screwed up and the wrench is removed to the tool stand. This testing and adjusting should be repeated as often as may be necessary until the tool is set square with the work. In the following tables, however, allowance has been made for only one adjustment for this should be ample for a skilled workman.

If square nose finishing tools are used in both heads at the same time—although this practice is not to be recommended—the time allowed should be the total times given in Tables 27 or 28, and 31 or 32, inasmuch as the tool cannot be set square and the various adjustments made with the table in motion.

The operations of setting square nose tools may be combined with the final element of the previous operation, as has been explained above for round nose roughing tools. If this is done the necessary deduction should be made from the tabulated time to cover the saving made by combining the several elements of the two operations.

Remove Tool from Tool Post

The table relating to the operation of removing the tool from the tool post assumes that the workman has stopped the machine from his operating position at the end of the cross rail. He obtains a

TABLE 25

SETTING TOOLS IN TOOL POST AND TIGHTENING FOR ROUGHING CUT ON OUTSIDE DIAMETER—ROUND-NOSE TOOL IN RIGHT-HAND HEAD

Tools required: Open end wrench.
Normal position of man: At end of cross rail.

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Obtain tool and wrench from stand	0 060	0 060	0 065	0 080	0 090
2. Put tool in post........	0 040	0 042	0.045	0 055	0 060
3. Tighten ¾-in. set screw	0 140*	0.210†	0.210†	0 210†	0.210†
4. Remove wrench to stand	0 035	0 040	0 045	0 055	0 070
Total time to set tool .	**0.28**	**0.35**	**0.37**	**0.40**	**0.43**

* Two set screws to tighten.
† Three set screws to tighten.

TABLE 26

SETTING TOOLS IN TOOL POST AND TIGHTENING FOR ROUGHING CUT ON FACE—ROUND NOSE TOOL IN RIGHT-HAND HEAD

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
Total time to set tool..	**0.28**	**0.28**	**0.30**	**0.33**	**0.36**

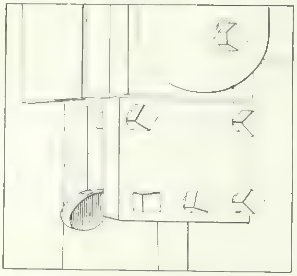
Note: The operations in setting a roughing tool for a facing cut are the same as those in setting it for a cut on an outside diameter, as given in Table 25, with the exception that only two set screws are tightened in the tool post.

TABLE 27

SETTING TOOLS IN TOOL POST AND TIGHTENING FOR FINISHING CUT ON OUTSIDE DIAMETER—SQUARE NOSE TOOL IN RIGHT-HAND HEAD

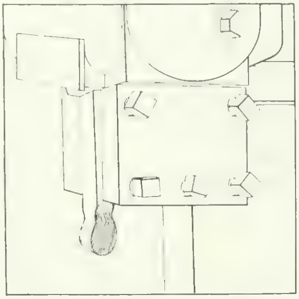
Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Obtain tool and wrench from stand	0 060	0 060	0 065	0.080	0 090
2. Put tool in post with cutting edge against work........	0.140	0 150	0 160	0 190	0 230
3. Tighten lightly ¾-in. set screws	0.140*	0.210†	0.210†	0.210†	0.210†
4. Set head back for clearance	0 040	0 040	0 040	0.050	0 070
5. Start table, test tool for bearing and stop table	0.190	0.190	0.190	0 200	0.210
6. Adjust tool to bearing.	0.170	0.170	0 180	0 190	0 200
7. Start table, test tool for bearing and stop table	0 190	0.190	0 190	0 200	0.210
8. Tighten firmly ¾-in set screws........	0.140*	0 210	0 210	0 210	0.210
9. Remove wrench to tray.	0.035	0 040	0 045	0.055	0 070
Total time to set tool..	**1.11**	**1.26**	**1.29**	**1.39**	**1.50**

* Two set screws to tighten.
† Three set screws to tighten.

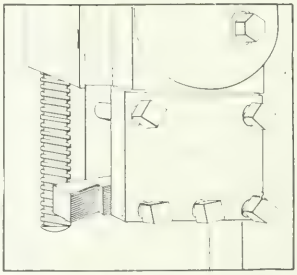

ROUGHING CUT ON OUTSIDE DIAMETER

wrench from the tool stand, loosens the tool-post set screws and removes both wrench and tool to the stand.

Ordinarily tools are used in the right-hand head only of double head machines. If, however, the left-hand head is not used the workman will have to traverse a greater distance between the tool stand and the head. This additional travel is taken into account in Tables 35 and 36 and these tables should be used in preparing an instruction card to cover this situation.

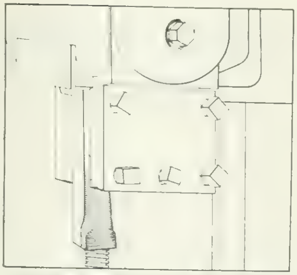

ROUGH-FACING CUT, GISHOLT VERTICAL BORING MILL

If tools are used in both heads, the time allowed on the card should be the same as the times allowed in Tables 33 or 34, and 35 or 36, if the workman is to remove the two tools separately to the stand. If, however, he is to remove the tool from one head and carry it and the wrench to the other head, remove the second tool and then transfer both tools to the tool stand at the same time, a deduction should be made of items 1 and 3 of Table 34, inasmuch as these items will appear but once, but in practice the time expended in making the deduction does not warrant taking it into account. A detailed instruction card covering this operation for a 42-inch mill will be given in the table of times on page 183, where the time for each operation will be found.


TOOL SECURED IN TOOL POST READY FOR FINISHING CUT ON OUTSIDE DIAMETER VERTICAL BORING MILL

An exception to the rule for allowing additional time for the removal of the second tool is made in those cases where the two tools are so far apart in their cuts that there is ample time to remove the first tool before the second one has finished its cut. In this event the workman will move the head back from the work while the machine is in motion as soon as the first tool reaches the end of its cut and will then remove that tool.

No allowance need be made for this operation, however.



FINISHING FACING CUT ON VERTICAL BORING MILL

On completion of the first or roughing cut, the round nose tool has to be removed from the tool post and replaced, with the wrench, on the tool stand. A similar operation should be performed on the completion of any other cut. The removal of the tool requires first the loosening of the holding screw, the removal of the tool from the post and the placing of the tool and wrench on the tool stand. Elementary time tables covering these operations for roughing and finishing tools in either hand head, giving the operation details and unit times, were given in a preceding article.

	Time in minutes
1. Obtain wrench from stand (Item 1, Table 32)	0.060
2. Loosen (3) ¾-inch set screws, right-hand head (Item 2, Table 32)	0.150
3. Move to left-hand head (½ of item 2, Table 34)	0.048
4. Loosen (3) ¾-inch set screws, left-hand head (Item 2, Table 32)	0.150
5. Return tools and wrench to stand (½ Item 2, Table 34, plus Item 3, Table 32)	0.098
Total time for removing both tools.	0.506

Ordinarily the tools are used in the right hand head and the operations of setting the tools in the left-hand head are identical, but the workman has to traverse a somewhat greater distance to place the tools in the left-hand head. In the case of finishing tools, more adjustment of tool is necessary than when setting a roughing tool. The detailed operations and unit times for the various acts in setting tools for the different sizes of mills have been itemized in the tables, and the manipulation of the machine previous to starting cuts for Gisholt boring mills were presented collectively.

The removal of metal takes place between the fundamental operations of setting tools and manipulating the machine for the various cuts.

Table 29
SETTING'TOOL IN TOOL POST AND TIGHTENING FOR ROUGHING CUT ON OUTSIDE DIAMETER—ROUND NOSE TOOL IN LEFT-HAND HEAD
Cutting Tool With Other Head from that Shown With Table 25

Tools required: Open end wrench.
Normal position of man: At end of cross rail.

	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Time for setting tools as in Table 25.....	0.365	0.400	0.430
2. Additional time required to walk to left of machine and return	0.096	0.110	0.160
Total time required to set tool	**0.46**	**0.51**	**0.59**

Table 28
SETTING TOOLS IN TOOL POST AND TIGHTENING FOR FINISHING CUT ON FACE—SQUARE NOSE TOOL IN RIGHT HAND HEAD

	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
Total time to set tool	1.11	1.12	1.15	1.25	1.36

Note: The operations in setting a finishing tool for a facing cut are the same as those in setting it for a cut on an outside diameter, as given in Table 27, with the exception that only two set screws are tightened.

Table 30
SETTING TOOLS IN TOOL POST AND TIGHTENING FOR ROUGHING CUT ON FACE—IN LEFT-HAND HEAD
Cutting Tool in Other Head from that Shown by Table 26

	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Time for setting tool as in Table 26.....	0.295	0.330	0.360
2. Additional time required to walk to left side of machine and return..	0.096	0.110	0.160
Total time for setting tool	**0.39**	**0.44**	**.052**

Note: The operations for setting tools in the left-hand head of the various machines are the same as for setting them in the right-hand head. The workman, however, has a longer distance to walk from the tool stand to the head and return, necessitating an additional time allowance.

Table 31
SETTING TOOL IN TOOL POST AND TIGHTENING FOR FINISHING CUT ON OUTSIDE DIAMETER—SQUARE NOSE FINISHING TOOL IN LEFT-HAND HEAD
Cutting Tool in Other Head from that Shown by Table 27

	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Time for setting tool as in Table 27.....	1.290	1.385	1.500
2. Additional time required to walk to left side of machine and return	0.096	0.110	1.160
Total time for setting tool	**1.39**	**1.50**	**1.66**

When the preparatory operations of landing the work on the boring mill table and the manipulation required to set the piece to run true and to secure it in the machine have been performed, then the tools have to be set and the machine manipulated before commencing th actual operation of removing metal. If several cuts have to be taken or if the machining of more than one surface is called for, the setting of tools and the manipulation of the machine may occur several times, also the removal of tools, with machining operations interspersed. In the actual performance of the complete machine operation the sequence of fundamental operations has to be strictly adhered to, but in presenting elementary time tables by which the rate for the various fundamenal operations may be set, it is advisable to deviate considerably from the schedule of operations, particularly as all of the fundamental operations which may be performed on the machine need not be necessary for a particular piece of work, or the order in which the fundamental operations are performed may differ.

Table 32

SETTING TOOL IN TOOL POST AND TIGHTENING FOR FINISHING CUT ON FACE—LEFT-HAND HEAD

Cutting Tool in Other Head from that Shown with Table 28

	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Time for setting tool as in Table 28	1.150	1.245	1.360
2. Additional time required to walk to left side of machine and return	0.096	0.110	0.160
Total time for setting tool	**1.25**	**1.36**	**1.52**

The workman is assumed to be at the operating position at the end of the rail before beginning each operation and he procures both the tool and the tool post wrench from the tool stand at the same time. He inserts the tool for the first cut in the post, tightens the set screw and returns the wrench to the tool stand. These are acts common to all tool setting operations, irrespective of the type of tool or the surface machined, are somewhat more complicated in the case of the finishing tools, or if the tool is placed in the left-hand head of the larger boring mills (42, 60 or 84-inch)—the head to the left of the workman as he stands in front and faces the machine—an additional time allowance should be made.

Table 33

LOOSENING AND REMOVING SQUARE AND ROUND NOSE TOOLS SET FOR CUTS ON OUTSIDE DIAMETERS—RIGHT-HAND HEAD

Refer to Illustrations with Tables 25 and 27

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Obtain wrench from stand	0.050	0.050	0.060	0.070	0.080
2. Loosen ¾-in. set screws	0.100*	0.150†	0.150†	0.150†	0.150†
3. Remove tool and wrench to stand	0.040	0.045	0.050	0.060	0.080
Total time to remove tool	**0.19**	**0.25**	**0.26**	**0.28**	**0.31**

* Two set screws to loosen.
† Three set screws to loosen.

Table 34

LOOSEN AND REMOVE SQUARE AND ROUND NOSE TOOLS SET FOR CUTS ON FACE—RIGHT-HAND HEAD

Refer to Illustrations with Tables 26 and 28

	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
Total time to remove tool	**0.19**	**0.20**	**0.21**	**0.23**	**0.26**

Note: The operations for removing tools set for a cut on face, from the tool post are the same as for a tool set for a cut on an outside diameter, excepting that there are but two set screws to loosen.

Table 35

LOOSEN AND REMOVE SQUARE AND ROUND NOSE TOOLS SET FOR CUTS ON OUTSIDE DIAMETERS—LEFT-HAND HEAD

Cutting Tool in Other Head from that Illustrated with Tables 25 and 27

	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Time for removing tool as in Table 33	0.260	0.280	0.310
2. Additional time required to walk to left of machine and return	0.096	0.110	0.160
Total time for removing tool	**0.36**	**0.39**	**0.47**

Table 36

LOOSEN AND REMOVE SQUARE AND ROUND NOSE TOOLS SET FOR CUTS ON FACE—LEFT-HAND HEAD

Cutting Tool in Other Head from that Shown with Tables 26 and 28

	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Time for removing tools as in Table 34	0.210	0.230	0.260
2. Additional time required to walk to left side of machine and return	0.096	0.110	0.160
Total time to remove tool	**0.31**	**0.34**	**0.42**

Note: The operations for removing tools from the left-hand head of the various machines are the same as for removing them from the right-hand head. The workman, however, has a longer distance to walk from the tool stand to the head and return, necessitating an additional time allowance.

How to Determine Cost of Living in An Industrial Community

By Ray M. Hudson

Much attention is being given at the present time to the matter of the cost of living as influencing wages. But it is no easy task to find out if living costs have really increased or decreased and just how much the net change has been. So Mr. Hudson's *article is of peculiar interest. It gives in complete detail the basis and results of a cost study made for the H. H. Franklin Mfg. Co.*

Mr. Ray M. Hudson, *after completing his education as mechanical engineer, entered the employ of the H. H. Franklin Mfg. Co. and served two years as a machinist and mechanic. During the next two years he was a traveling engineer for this Company, studying the performance of cars. In 1911 he became superintendent of the Service Shops, and in 1916 was appointed employment superintendent of the factory as a whole. In this position he had charge of the usual employment functions and in addition applied the wage rating method developed by Colonel George D. Babcock. In 1917 he became assistant to Colonel Babcock. In January, 1918, he entered the employ of the Emergency Fleet Corporation and is now special assistant to Mr. C. M. Tuthill in charge of the organization of the supply division.*

THE maintenance of equitable and satisfactory relations between employer and employee centers about the wage question. Conversely, industrial unrest is most commonly due to the differences in the estimate by the employer, and the estimate by the employee of the monetary value of the employee's services. If men stay at a plant continuously year after year, it is because they are satisfied with: First, the wages; second, the work; third, the treatment. If they leave rapidly, i. e., if the turn-over is high, it is chiefly because of dissatisfaction arising in regard to conditions in the order named.

In recognition of these facts, Colonel George D. Babcock formerly production manager of the H. H. Franklin Manufacturing Company's plant, devised a method of wage-payment in 1915 and applied it practically in 1916 wherein each man's wage rate is determined by the facts of his individual record as a workman. (Details of this method were published in INDUSTIAL MANAGEMENT and later in Col. Babcock's book "The Taylor System in Franklin Management.") The essentially individual factors are as follows:

1. The quantity of work done by the man, or his output.
2. The quality of that work reflected by the number of good pieces made or finished.
3. His attendance record.
4. His years of continuous service.
5. His degree of versatility reflected by the number of major processes he can do.
6. His conduct and coöperation record.

But, in order to maintain proper industrial contentment or peace, the cost of living is also carefully considered in this method of wage-rating. That it is of vital importance, is shown by the following quotation from an article by Mr. G. Garrett, editor of the Finance and Economics Departments of the *New York Tribune,* published November 27, 1916.

> It is absurd that there should be two kinds of wages. Nevertheless, it is a fact. When we speak of money wages, we mean the number of dollars the worker receives in his pay envelope. When we speak of *real wages*, we mean the amount of goods those dollars will buy. If the number of dollars in the pay envelope remains the same and the price of everything that the dollar buys has increased, then we say that money wages are stationary and real wages have fallen because the same number of dollars will buy less goods.

CYCLE OF INDUSTRIAL CONDITIONS

It is a well-known economic truth that invariably the increase in the cost of living outstrips the increase in wages. This is proven by the following cycle of industrial conditions:

1. Increased cost of living.
2. Internal Economics in the home finances coincident with a reduction of the standard of living as heretofore maintained.
3. Increasing personal dissatisfaction with the conditions causing this lowering of that standard.
4. The natural reaction expressed in the request to the employer for higher wages.
5. If that request is not met adequately and promptly, industrial unrest with consequent labor disturbances arise and, like any other ill, imaginary or real, the longer brooded over the worse it seems and the more difficult is the return to the normal state of mind. On the other hand, if granted by the employer the return to temporary peace or industrial contentment is almost immediate. The employer, of course, has the alternative of either charging the consumer a higher price for his product (thus tending to increase living costs still further, and sooner or later starting this cycle again), or increasing his output and through internal economies, resulting from better bethods of operation and management, lower the price of his product, thus aiding in a lower living cost.

Modern thought along these lines considers the annual increase in wages as a real and vital part of the costs just as much as the depreciation of machinery or buildings. In other words, this wage increase must be anticipated and met in order to maintain a highly effective organization and personnel of the working force.

However, the conditions in the past year have been so unusual that it becomes a point for grave consideration as to whether or not it is entirely, or only partly, up to the employer to assume the responsibility of meeting through wage increases to his employees, the enormous increase in their living costs which still exists after each one has done his bit along conservation lines by sacrificing some part of his ante-bellum living standard.

A despatch from Washington dated November 18, 1917, reads: "Industrial history proves that reasonable hours, after working conditions, and a proper wage scale are essential to high production. During the war an attempt should be made to conserve in every possible way all of our achievements in the way of social betterment."

The recommendations above given from Washington have long been the ideals and the practices of the H. H. Franklin Manufacturing Company; and consequently, while the cost of living has increased considerable over

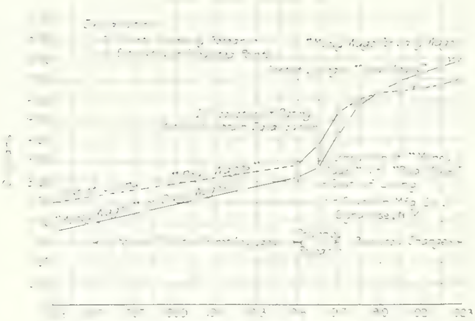


FIG. 1. CHART SHOWING TREND OF COST OF LIVING

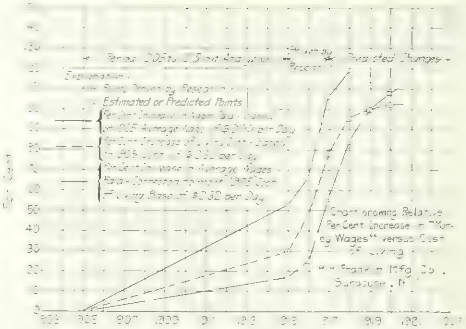


FIG. 2. INCREASE OF LIVING COSTS BY PERCENTAGES

1916 (for the same standard of living), wages increased at a relatively faster rate over the 1916 scale in recognition of the new conditions. See the curves of Figures 1 and 2.

Approach to the Problem

To determine the relative cost of living since 1905, it was necessary to take into consideration the principal elements of the four essentials: food, clothing, fuel and shelter.

1. *Territory.* The locality contiguous to the plant of the H. H. Franklin Manufacturing Company, this territory being that in which the larger part of the workers reside.
2. *Family size.* The average working man's family consisting of himself, his wife and three children—two boys, aged 15 and 9, respectively, and one girl, aged 7.
3. *Food.* The average table such as a good workman desires, taking the typical meals per day, breakfast, dinner, and supper, for four periods of the year, Spring, Summer, Fall and Winter.
4. *Clothing.* The clothing which this family desires for proper warmth, protection, and appearance consistent with their responsibilities.
5. *Fuel.* The fuel required for warming the dwelling in which they live, and also that used in cooking the food they consume.
6. *Shelter.* The typical home, its accessed valuation, and the annual taxation, assuming the thrifty workman to own his own home.

Comparisons and Conclusions

It is evident that the percentage of increase in wages calculated on the 1905 wage basis is actually greater in 1915, 1916 and 1917, respectively, than is the percent of increase in living cost reckoned on the 1905 living cost basis. However, a direct comparison in dollars and cents makes these percentages misleading. Therefore, in order to obtain a true comparison of the relative rate of increase, let us assume the 1905 cost of living as the basis for calculating the percentage of wage increase, and we find that wages in 1915, 1916 and 1917 increased 16.8, 25.2 and 53.8 per cent., respectively, while the cost of living calculated on the same basis increased 29.8, 46.8 and 78.8 per cent., respectively in 1915, 1916 and 1917.

Referring to the curve, if this same tendency of wages to gain on the cost of living continues annually, it is safe to predict that in a few years more money wages will overtake and pass real wages. This is in line with the modern trend in management and foretells the time when, after the war, and the natural, obvious readjustments occur and conditions are again stabilized, there will be a new era of peace, industrial contentment and prosperity.

After the close of the Napoleonic wars money wages and prices fell, as is bound to happen after every period of war inflation, but real wages actually rose because prices declined faster than money wages. After that came many vicissitudes, periods of inflation and of depression, prices and money wages going up and down, but

Table 1

LIVING COSTS FOR 1905, 1915, 1916 AND 1917

The following figures show the actual daily cost for the four essentials, food, clothing, fuel and shelter, based on 300 working days per year, for in that time the worker must earn sufficient money to provide for his family for the 365 days in the year.

Essential	1905	1915	1916	1917	Notes
Food	1.34	1.776	1 994	2 561	Average daily cost of typical menus for the four mid-season periods.
Clothing	0 70	0 77	0 935	1 124	Average daily cost for principal articles for typical family.
Fuel	0.26	0.255	0.280	0.298	Average daily cost for fuel for typical family.
Shelter	0 32	0.60	0.64	0.704	Four times the daily cost of taxes for shelter for typical family.
Totals	2.62	3.40	3 849	4 687	Daily living cost of these essentials for typical family.
Increase over 1915 living cost		0 78	1 229	2 067	Direct subtraction of 1905 cost from cost for year considered.
Per cent. of increase		29.8	46 8	78 8	Using 1905 as the base year.

Table 2

WAGES FOR 1905, 1915, 1916 AND 1917

These figures are obtained by dividing the actual payroll for the week considered by the total hours of work done, i. e., services rendered by the department for this same week. This gives the average hourly earnings, and multiplying that by the normal hours of the working day, gives the average daily *earnings* in dollars per man in the department.

Department No.		1905 Average Earnings	1915 Average Earnings	1916 Average Earnings	1917 Average Earnings
A.	All machine-shops	2.10	3.92	3.67	4.46
B.	Finished stock	1.79	2.19	2.20	2.83
C.	Wood shop	2.69		3.48	4 53
D.	Engine assembly	2.14	3.18	3.45	4.20
E.	Wood pattern	2.50	3.74	4.03	4.64
F.	Millwrights	1.35	2.27	2.98	4 03
	Average	2 00	3.06	3.30	4.13
	Increase over 1905 daily earnings	Base	1 06	1.30	2.13
	Per cent. of wage increase	Base	53	65	106 5

always with real wages tending to rise so that, in the nineteenth century, the purchasing power of the average earner in Great Britain practically doubled. It is to be regretted that American statistics on this subject are imperfect, but charts and tables of American prices would exhibit, in the main, the same features of profile, for the law is the same in both cases.

Table 3 is reproduced from Palgrave's "Dictionary of Political Economy," showing in contrast the fluctuations of English wages and prices for more than a century past. It is believed that American wage and price fluctuations are analogous if not coincident.

TABLE 3

FLUCTUATIONS IN WAGES AND PRICES

Periods	Money Wages	Prices	Real Wages
1790–1810	Rising fast	Rising very fast	Falling slowly
1810–1830	Falling	Falling fast	Rising slowly
1830–1852	Nearly stationary	Falling slowly	Rising slowly
1852–1870	Rising fast	Rising	Rising
1870–1873	Rising very fast	Rising fast	Rising fast
1873–1879	Falling fast	Falling fast	Nearly stationary
1879–1887	Nearly stationary	Falling	Rising
1887–1892	Rising	Rising and falling	Rising
1892–1897	Nearly stationary	Falling	Rising
1897–1900	Rising fast	Rising	Rising
1900–1904	Falling a little	Falling and rising	Rising

The experience of wage earners in Great Britain is that of wage earners in all countries comparable to Great Britain in terms of efficiency and governed by the same quality of economic thought. After the close of the current period, we shall have a fall in both money wages and prices, but if experience holds, money wages will fall relatively little.

When prices fall faster than money wages, as invariably they tend to do, the profits of capital are reduced—that is, the incentive to greater efficiency of production—and it is because capital finds the means to produce goods more cheaply in order to pay a higher money wage and still make a profit that it is possible for real wages to rise.

So, perhaps in awkward consequence of the abnormal things now taking place, the command of the wage earner over the goods of the earth will be doubled again in the twentieth century.

Method of Analysis

The year 1905 is chosen as the base year for comparison because in 1904, 1905 and 1906 the rates seem to have been fairly uniform. The workers then were not working premium; men were selling their services for a straight day rate and were satisfied with their wages. In connection with this, Col. Babcock says, "The exact increase in the cost of living is very difficult to determine, but after a careful study in this city, it was found that table commodities, assessed valuation of property, tax rates, and fuel had increased approximately 50 per cent. since 1905 up to 1916. Since the increase in living cost is applied to the rate in 1905, and since the living at that time was measured by the base rate then received, it will be obvious that the increase in cost of living factor provides for the different conditions under which workers live at the present time."

In other words, an engine lathe operator, who drew 25 cents an hour in 1905, must draw at least 44½ cents an hour at the present date to live at the same standard.

Method Ap[illegible] 1916

Referring to the statement of the problem, we first considered that the relation the research bears to the problem of adequate and equitable wage payment to the workers depends on the accuracy of the data; in other words the value of a research depends upon its being *based on fact.*

Reconsidering the various items involved in the 1916 research in regard to territory we reviewed the files of employees and found that the majority of them live within a radius of one or possibly three-quarters of a mile from the plant. From our knowledge of the personnel of the employees it was decided that a family of five is typical, and that the family consists of the father as the sole means of support, the mother and three children. We assumed the latter to be two boys aged 15 and 9, respectively, and a girl aged 7, although the cost of living for children does not vary greatly at these ages for either sex.

From interviews with a number of workmen, typical menus for the four mid-season days were secured. The menus for each day from each family were averaged until we obtained the normal menu shown herewith. The amounts of each article of foods consumed each day by the family considered were then carefully computed and estimated from the data given us by the workmen; also from consultation with housewives and standard cookbooks.

From the Eighteenth Annual Report of the U. S. Commissioner of Labor, we found that reckoning the consuming power of a man as 100 per cent., the woman consumes 80, the boy of 15 to 80, the childe 10 to 13, 60, and the child 6 to 9 years 50 per cent. of the man. This gives a total consuming power for the family of 3 7/10 adult males.

Local food prices in the markets where these people trade were obtained from the files of the Syracuse *Post-Standard,* and also through consultation with the dealers themselves. Care was exercised to get similar grades and quantities for the years compared, and our inability to do this in some instances resulted in the substitution of similar articles about which there was no doubt.

On the daily sheets showing menus, were put the amounts consumed of the various commodities, milk was figured at the same prices throughout the year due to our inability to obtain the price variations for the seasons. Retail milk prices vary but little through the year and the wholesale prices are reflected fairly close in the prices of cheese. Bread prices fluctuations have been included in flour, lard and milk as it was not possible to get the weights of the loaves from season to season or year to year. To wholesale food prices used, we added the usual margin of profit: Coffee, 8 cents per pound, flour 12½ per cent., strawberries, 2 cents per quart over crate quotations.

Sugar was calculated at wholesale prices as it varies so slightly from retail prices and is most often sold at actual cost as a trade puller.

Clothing costs were obtained from estimates of a number of workmen, and then combined to amounts required for a family of five. The total cost for this family was $220 per annum, and on the average income of $1378 per annum amounted to 15.9 per cent. of the annual budget. (Chaplin in his study of New York City families, gives $155.57 as the clothing expense for an income of $1000 to $1100 or 15.5 per cent. (See "Standard of Living" by Streightoff, pages 174-175.)

Local coal prices were obtained for April of each year and increased 10 cents per month until September. This arrangement prevailed all over the city from 1902 until the fall of 1916. Striking an average price for the year and using actual figures for the tons consumed, we have arrived at the daily cost of fuel. Gas for cooking and lighting was also included.

The figures for shelter were based on assessed valuations and the tax rate prevailing in each year. They are obviously comparable to rentals charged by landlords, for if tax rates or assessments go up separately or together, rents are increased accordingly. The tax rate of 1915 of $27.37 for the combined city, county and state tax was used, and it was not seen fit to reduce this figure to the one for the current year. This is estimated by city officials to be $2 less per $1000 due to the absence of the direct state tax in 1916. It has been assumed that if rents did go up according to the 1915 tax rate there would be no reduction in rents this year due to the absence of the direct state tax, but that the owners of renting property would themselves absorb the increased revenue.

TABLE 4
INCREASES IN FOOD COSTS

	Per Cent. of Increase in Food Costs of Jan., 1917, Over Jan., 1916	Per Cent. of Increase in Food Costs of April, 1917, Over April, 1916	Per Cent. of Increase in Food Costs of July, 1917, Over July, 1916	Average
H. H. Franklin Mfg. Co.	28.2	31.2	24	27.8
U. S. Government (weighted average)	19.2	33 1	30 3	27.5

The assessment on 21 parcels of property identical in size and description as nearly as could be judged from the city records, was considered. These parcels are all located on the city streets within the territory above referred to.

Additional items in the cost of living as medical attendance such as incidental to the raising of a family, dental work, etc., have not been included, nor other expenses such as household furniture, insurance or savings. These are provided for by the finally determined percentage rate increase in which food, clothing, fuel and shelter are the principal items. Pleasures, luxuries and other matters of personal choice can be taken from premium earnings. Throughout all calculations it was considered that the worker must bring in during the 300 working days of the year sufficient income to provide for proper sustenance for the 365 days of the year.

TABLE 5
SUMMARY OF FOOD COSTS

Day	1905	1915	1916	1917
January 15	0.957	1.274	1.504	1.929
April 15	1.071	1.303	1.502	1.972
July 15	1.215	1.568	1.700	2.108
October 15	1.17	1.68	1.85	2.412
Total	4.413	5.843	6.556	8.421
Average	1.103	1.46	1.693	2.105
Average x $\frac{365}{300}$	1 34	1 776	1.994	2 561

TABLE 6
TYPICAL MENUS FOR EACH SEASON

January 15	April 15	July 15	October 15
	BREAK	FAST	
Toast Coffee Hamburg steak Oatmeal	Wheat cakes and Maple syrup Coffee Oatmeal & toast	Scrambled eggs Coffee Bread and butter Cookies (molasses)	Potatoes Ham, toast Coffee Cornmeal mush
	DIN	NER	
Roast pork Potatoes Boiled onions Bread and butter Tea Baked apples	Stewed beef Potatoes Bread and butter Rice pudding Parsnips Tea	Round steak Potatoes Fresh peas Rhubarb pie Bread and butter Tea	Chicken and biscuits Squash Carrots Biscuits, butter Apple pie Tea
	SUP	PER	
Cheese on toast Potatoes Tea Bread and butter Apple pie	Fried ham Scrambled eggs Potatoes Bread and butter Sauce, tea & cake	Potato salad Strawberries Cookies Bread and butter Tea	Hash (pot roast) Sliced tomatoes Bread and butter Tea Baked apples

While the standardized method adopted October, 1916, was followed in the check-up for 1917, the unusual conditions prevailing at that time have made unusual methods necessary to check in every possible manner, the accuracy of the figures obtained. Two additional methods were therefore adopted which are new to the 1917 study.

TABLE 7
DAILY FOOD COST FOR JANUARY. 1915

Articles	Quantities	Price 1916	Price 1917	Cost Per Day, 1916	Cost Per Day, 1917
Sugar	1 lb.	0.06	0.07	0.06	0.07
Butter	⅓ lb.	0.32	0 385	0.107	0.128
Coffee	5 cups	0 275	0 275	0 0343	0.0343
Tea	½ oz.	0.50	0.65	0.0156	0.0203
Oatmeal	½ lb.	0.05	0.065	0.025	0.0325
Hamburg	1½ lbs.	0.115	0.135	0.175	0.2025
Apples	½ pk.	0.219	0.25	0.1095	0.125
Potatoes	1½ qts.	0.281	0.481	0.0527	0.09
Onions	1 qt.	0.125	0.22	0.0312	0 055
Milk	1 qt.	0.095	0.10	0.095	0.10
Flour for pancakes, bread, cookies, etc.	1 lb.	7.37 3.92	10.54 3.92	0.0189	0.0268
Roast pork	4 lbs.	0.135	0.18	0.54	0.72
Cheese	1 lb.	0.1775	0.235	0.1775	0.235
Lard	4 oz.	0.1175	0.17	0.0294	0 04
Eggs	1/12 doz.	0.425	0.60	0.0354	0 05
Totals.	..	..	...	1 504	1 9294 = 28 2% increase

The methods adopted in 1916 and followed in 1917 are reviewed as follows:

1. Wholesale and retail market reports from Syracuse newspapers.

TABLE 8
DAILY FOOD COST FOR APRIL 15

Articles	Quantities	Price 1916	Price 1917	Cost Per Day 1916	Cost Per Day 1917
Butter	⅓ lb.	0.325	0.435	0.1083	0.145
Sugar	1 lb.	0.074	0.085	0.074	0.085
Coffee	⅛ lb.	0.23	0.23	0.0287	0.0287
Tea	½ oz.	0.50	0.65	0.0156	0.0203
Stew beef	3 lbs.	0.13	0.15	0 39	0.45
Eggs	⅚ doz.	0.223	0.31	0.1874	0.258
Ham	1½ lbs.	0.195	0.265	0.2925	0.3975
Milk	2 qts.	0.095	0.10	0.19	0.20
Rice	½ lb.	0.08	0.11	0 04	0.055
Cornmeal	½ lb.	$32 ton plus ½c. = .021	$32 ton plus ½c. = .021	0.0105	0.0105
Maple syrup	½ pt.	1.25 gal.	1.50	0.0701	0.0937
Flour for cookies, bread and wheatcakes	1 lb.	5.975 plus 12½% = 6.72 3.92	11.85 and 12½% = 13.23 3.92	0.01714	0 03375
Potatoes	1½ qts.		3.05 bu.	0.05268	0.14296
Parsnips	1 qt.	0.45 bu.	1.675 bu.	0.0171	0.0523
Totals				1 50202	1.9726 = 31 3% increase

2. Syracuse retail grocers.
3. Syracuse retail coal offices.
4. Syracuse department stores.

In addition these methods peculiar to the 1917 check were applied:

By consultation with working men of the H. H. Franklin Manufacturing Company.

1. Five married men.
2. Five single men, United States Government figures.

Table 9

DAILY FOOD COST FOR JULY 15

Articles	Quantities	Price 1916	Price 1917	Cost Per Day 1916	Cost Per Day 1917
Bacon........	¾ lbs.	0.1959	0.335	0.1462	0.2512
Eggs.........	8⅔ doz.	0.27	0.36	0.18	0.24
Coffee........	⅛ lb.	0.24	0.24	0.03	0.03
Tea..........	½ oz. daily	0.50	0.65	0.0156	0.0203
Round steak	1½ lbs.	0.14	0.1725	0.21	0.2587
Fresh beets...	3¼ doz.	0.45	0.50	0.1125	0.125
Butter........	1 lb.	0.31	0.41	0.31	0.41
Peas.....	1 pk.	0.95	1.125	0.237	0.14062
Potatoes......	1½ qts.	0.825	0.34	0.1546	0.0637
Milk..........	1 qt.	0.095	0.10	0.095	0.10
Flour, cookies, bread, etc.	1 lb.	5.35 plus 12½%= 9.60 3.92	11.88 plus 12½%= 13.36 3.92	0.0244	0.0340
Molasses.....	½ pt.	.	0.55	0.0562	0.0343
Strawberries..	2 qts.	0.08	0.132	0.16	0.264
Lard.........	7 ozs.	0.1675	0.274	0.0732	0.1198
Rhubarb.....	1 bunch.	0.125	0.20	0.01125	0.0166
Totals...	.		.	1.8159	2.108 16% increase

1. Actual retail prices obtained from the *Monthly Bulletin* of the United States Bureau of Labor Statistics.

2. Weighted average increase in price for 23 staple articles of food.

Table 10

DAILY FOOD COST FOR OCTOBER 15

Articles	Quantities	Price 1917	Price 1916	Cost Per Day 1916	Cost Per Day 1917
Coffee........	5 cups= ⅛ lb.	0.24	0.24	0.03	0.03
Tea..........	½ oz. daily	0.50	0.65	0.0156	0.0203
Potatoes......	1 qt.	0.306	0.387	0.0382	0.0483
Chicken......	2½ lbs.	0.225	0.29	0.6375	0.725
Squash.......	1	0.0175	2½ to 4c.	0.0175	0.0325
Apples.......	1 pk.	0.219	0.40	0.219	0.40
Milk..........	1½ qts.	0.095	0.11	0.1425	0.165
Butter.......	4 ozs.	0.355	0.50	0.0887	0.125
Eggs.........	1-1/12 doz.	0.40	0.55	0.0333	0.0458
Carrots.......	1 qt.	0.193	0.187	0.0241	0.0234
Lard.........	6 ozs.	0.1675	0.265	0.0632	0.0990
Flour for pie, bread, etc....	2 lbs.	9.603 3.92	10.45 plus 12½%= 11.75 3.92	0.0489	0.399
Ham.........	1½ lbs.	0.205	0.28	0.3075	0.42
Tomatoes.....	1 qt.	1.05	1.375	0.039	0.0429
Pot roast.....	1 lb.	0.135	0.16	0.135	0.16
Cornmeal.....	½ lb.	0.021	0.03	0.0105	0.015
Totals.	.	.		1.85	2.412= 30.3% increase

Government Food Prices

Comparison with government figures of food prices for 23 staple articles of food averaged for the entire United States is very interesting. Our figures reflect only local conditions while government figures cover conditions in every locality, but invariably they back our statement that there has been a substantial increase in the price of nearly every staple food product.

The government submits no monthly clothing, fuel, or rental prices. Food prices from the *Monthly Bulletin* of the Bureau of Labor Statistics for January, April and July, 1915, 1916 and 1917, were obtained, and the prices of 23 of the principal commodities were listed, the actual cost set down, and the percentage increase as well. These percentages were then multiplied by the weight given by the government showing the relative importance of the various articles of food in the average family budget. These figures are based on a government investigation of the annual food expenditure for 1415 families in the North Atlantic States, made in 1901. The summation of these weighted averages, divided by the sum of the total weights, gives us our percentage increase for the entire food expenditure of an average family.

Table 11

FUEL IN OCTOBER

Item	Amount	Price Per Ton For		Annual Cost	
		1916	1917	1916	1917
Chestnut coal.	1.5 tons	$7.40	$7.60	$11.10	$11.40
Egg coal......	7.0 tons	7.40	7.96	51.80	55.72
Gas.. ...	25 M.	$1.00 M.	$1.00 M.	22.50	22.50
		Annual Cost Total..		$85.40	$89.62
		Daily Cost.......		$0.284	$0.298

Item	Amos Coal Co.		Millspaugh & Co.		Carrier Coal Co.	
	1916	1917	1916	1917	1916	1917
Chestnut coal....	$7.20	$7.75	$7.20	$7.60	$7.20	$7.50
Egg coal......	7.45	8.10	7.45	7.90	7.35	7.90

The close check between government figures obtained by this method and the local figures, is shown by the fact that the average increase in food prices from January, 1916 to July 15, 1917, is shown by the government weighted average of 27.8 per cent. against the local average of 27.5 per cent. Taken in shorter periods, the percentages differ, but over the entire period the figures almost coincide. See Table 4.

Checking Rental Increases

In the parcels of property examined last year there were but three on which the 1917 assessment was ahead of 1916. This is no indication of the real increase in rents in the city due to several causes. From all sources possible, the following reasons are cited as having increased rents from 20 to 25 per cent.:

A. Scarcity of flats and houses because of the increased number of people coming steadily into the city for the past year to take advantage of the high wages paid by manufacturers.

B. Owing to the 25 per cent. increase in the cost of building materials, not to mention labor, a house that could be erected one year ago for $5000 now costs $7000 and everything in proportion, so that fewer new houses or flats are being erected.

The general basis of the increase has been as follows: $12 flats raised to $14, $16 and $17 flats raised to $20, $20 flats raised to $25.

Table 12
TAX RATES INCLUDE CITY, COUNTY AND STATE TAXES

Street	Lot No.	Assessment			Taxes			Per Cent. Increase of 1916 over 1905	Per Cent. Increase of 1917 over 1905
		1905	1916	1917	1905 $20.70	1916 $24.52	1917 $25.57		
Clifford	544	1400	2100	2100	$28.98	$51.49	$53.70	43.7	46.
	546	1500	2150	2150	31.05	52.72	54.98	41.1	43.5
	618	2000	2800	2800	41.40	68.65	71.60	39.6	42.1
	620	1000	2000	2000	20.70	49.04	51.14	57.7	59.5
	727	700	1250	1250	14.49	30.75	31 96	53.8	54.6
Belmont	103	800	1200	1200	16.56	29.42	30.68	43.7	46
Elliott	425	700	1200	1200	14.49	29.42	30.68	50.7	52.7
	417	1000	1550	1550	20.70	38.00	39.63	46.5	47.7
	405	1000	1900	2000	20.70	46.59	51.14	55.55	59.5
Hudson	72	900	1200	1200	18.63	29.42	30.68	36.6	39.2
	108	1100	1400	1800	22.77	34.35	46.03	33.7	50.5
	104	800	1000	1000	16.56	24 52	25.57	32.4	35.2
	100	900	1800	1800	18.63	44.12	46.03	57.7	59.5
	81	1200	3000	3000	24.84	73.56	76.71	66.2	67.6
Rich	118	800	900	1100	16.56	22.07	28.13	24.9	41.1
	116	800	900	900	16.56	22.07	23.01	24.9	28.0
	86	1200	1500	1500	24.84	36.78	38.36	32.4	35.2
	98	1200	1900	1900	24.84	46.59	48.58	46.6	48.8
Palmer	342	2000	2200	2200	41.40	53 94	46.26	23.2	26.4
(mostly vacant 1905)	344	2600	5100	5300	53.82	125 05	177.33	56 9	69.6

Percentage of increase of 1917 over 1916 . . . . 3.3%

The increased costs of building are clearly shown in figures from the City Bureau of Buildings, as follows:

	1916	1917	1916	1917
New Buildings	1022	952	$3,909,780	$2,787,997
Remodeled	1021	770	785,258	1,260,720

These figures seem to indicate that remodeling was much cheaper than putting up new structures to meet the increased demand for houses by industrial workers.

It was generally agreed among real estate men, that the rents on the East side of the city, that is on streets adjacent to the Franklin works, was less than other sections, owing to the large number of foreigners who have bought property in this district, thus depreciating its value for rental purposes.

Information from the Workmen

From the workmen questioned there was general agreement that rentals had increased about 25 per cent.

No. 1 stated that his house rent went from $12 to $15 per month, or 25 per cent.

No. 2 stated he lives in the same house as last year and pays $13 now against $12 a year ago, or 8 per cent. increase.

No. 3 had no increase.

No. 4, a single man, paid $1.50 for his room in 1916, now he pays $2, or a 25 per cent. increase. This same man paid $4 per week for board in 1916 and $5 in 1917, or a 25 per cent. increase.

No. 5, a single man, pays $2 for a room that last year cost $1.75, or a 12½ per cent. increase. In board he had a 37½ per cent. increase.

Method of Checking by the Workmen

The question was frankly put to the ten workmen in the factory as to the actual prices they had paid for various articles of food and clothing during the past year as compared with the year previously. Only men of tested veracity and supposedly careful spenders were included in this list and answers showed a wide divergence as to the prices paid, showing clearly the ability of the housewife as a manager and careful buyer. For example: These purchasers showed the price of chicken to range from 30 to 40 cents per pound from 1916 to 1917. Our figures show a rise of from 22½ to 29 cents, about equal in percentage, but considerably less in price. The retail figures were obtained from the North Side Farmers' Market.

In nearly every instance, there is a substantial agreement between the working men and our figures in regard to meat prices—perhaps the most important single item in the food expense of the ordinary family.

In the clothing line the women were invariably agreed on a heavy increase in the cost of the price of coats for themselves. According to the most careful estimation, coats of the same quality as two years ago, can be purchased for the same or less money, the seeming increase in cost being due to the increasing demand for fine quality and scarcity of cloths.

The increased cost of living, as shown by our figures, cannot be taken as an indication for every family. There is an extremely wide divergence in the family expenses as shown by the various women questioned. The extent to which this is true is very well put in a study published November, 1917, in the *Annals of the American Academy*, and entitled "Food Prices Versus Wage Increases." The conclusions given there are for the City of Philadelphia, but they reflect women buyers in all other parts of the United States.

Purchasing at Cheapest Prices

One of the greatest factors in the struggle of the average working family against the ever-increasing price in food, clothing, etc., is the ability of the housewife to shop economically and avoid wastage. There is ofttimes a large discrepancy in the prices charged for meats and foods in various sections of the city. For instance, hamburg steak was quoted at three down-town markets for 14 cents per pound, and in three outlying markets on the same day, the average was 20 cents. The nat-

TABLE 13
ANALYSIS OF CLOTHING COSTS FOR ADULTS

Father	1905 and 1915 Quality Shown by Price	Chappell-Dyer Co.		Besse Sprague Co.		E. N. Edwards Co.		1917 Unit Price Taken	Quantity Per Year	Annual Cost	
		1916	1917	1916	1917	1916	1917			1916	1917
Winter overcoat	$15 00				$18.00	$15.00	$20 to $22	$18.00	3 yrs. weat	$5.00	$6 00
Raincoat	5 00	$5 00	$5.00	$15 00	5.00	5 00	5 00	5.00	1	2 00	2 00
Suit	15 00			15 00	16.50	15 00	18 00	18.00	1	15.00	18 00
Work pants	2 00			2.00	2.50	2.00	3.50	3.00	2	4.00	6 00
Work shirts	50	59	1 00		.70	65	.98	.35	3	1.95	2 25
Underwear, heavy wool	2.00	2.50	3 00	2 00	2.50	2.50	3 50		2	5 00	6 00
Underwear, light	1 00	1 25	1 50	1.00	1.25	1.25	1.75 to 1.98	1.50	2	2 50	3 00
Hats, soft	2 00			2 00	2.50	2.50	3.00	2.50	1	2 50	2 50
Hats, straw	1.50	1 50	1 50	1 50	1.50	1.50	1.50	1.50	1	2 00	1 50
Cap	1 00			1 00	1.00	1.25	1.50.	1 00	1	1 25	1 00
Shoes	2.50	4 00	5 50	2 50	4 00	3.00	4.00	4 00	3	12 00	12 00
Night shirts	.50	65	.79	50	.65	.65	.98	.65	2	1 18	1 30
Socks	.15	19	.25	.15	.20	.19	.29	.25	6	1 14	1 50
Rubbers	90			90	1.00	.90	1.10	1.10	2	1.80	2 20
Sweater vest	3 00	3 00	4 50	3 00	4.00	4.00	6.00	5.50	1	5.00	5 50
White shirts	1 00	1.25	1.35	1.00	1.15	1.25	1.35	1.25	2	2.50	2 50
Handkerchiefs	.125	15	.20	.125	.20	.15	20	165	12	1 80	1 98
Neckties	.25	.25	.35	.25	.25	.25	25	.35	4	1 40	1 40
Linen collars	.15	.15	.20	.15	.20	.15	20	.20	6	90	1 20
Suspenders	25	.35	39	.25	.35	.35	.50	.35	2	70	70
Total per year										$69 70	$79 53
Mother											
Coat, heavy, 3 years	$15 00	$19 50	$15.00			$19 50	$19.50	$19.50	3 yrs. wear	$16 00	$16 50
Suit	15.00	15.00	15.00			15.00	19.50	17.00	1	15.00	17 00
Work dress	1.00	1 25	1.50			1.25	1.50	1.50	2	2.50	3 00
Afternoon dress	1.50	1.50	1.98			1.50	1.98	1.90	2	3.00	3 80
Shirt waists	1 00	.95	1.00					1.00	2	2 00	2 00
Shoes	3.00	5.00				5 00		5.00	2	10 00	10 00
Hats	3.00	3.00				4 00		4 00	2	8 00	8 00
Night gowns	50	.65	1.00			60	98	1.00	3	1 80	3 00
Corsets	1.00	1.25	1.50			1.25	1 50	1.50	2	2 50	3.00
Stockings	.15	.19	.25			19	25	25	6	1 14	1 50
Shirts, woolen	1.25	1.25				1.50	1.98	1 98	2	3 00	3 96
Underwear, heavy	2 00					1.35	2.00	1 98	2	2 50	3 96
Underwear, light	50	.50	79			.59	.89	.79	2	1 18	1.58
Rubbers	.75	...	80			.75	.90	1.00	1	75	1 00
Handkerchiefs	.125	.15	20			.15	.20	20	12	1 80	2 40
Gloves, dogskin	1 00	1 25				1.15	2.00	1.75	2	2 30	3 50
Total per year										$63.97	$74.20

ural question here arises as to why the housewife does not choose the cheapest store, considering the general quality of the meat to be the same. The reason is that the average laboring family must establish credit at some store so that in case of sickness or lay-offs their supply of food will not be cut off. For this privilege they are often forced to pay somewhat higher prices, but it is considered an absolute necessity in the laboring man's scheme of life.

Another factor in the shopping of many of the women is the necessity of resorting to the highly expensive credit clothing parlors for clothes, not only for the men and women of the family, but for the children as well, all to be paid for on the installment plan. Most of these establishments charge from 25 to 35 per cent. more for the same garment than if bought for cash, figuring on the length of time needed for collections, the risk involved, etc. In a recent interview with the proprietor of one of the most successful of these establishments, he remarked that two-thirds of his patrons were from families of the manufacturing class.

Unity Versus Trade Unionism

By L. L. Warren

General Business [illegible]

A TRADE UNION is an association formed to further common interests by workmen skilled in a trade. Those who further trade unionism attract or interest others in a common cause, supposedly based upon demonstrating a practical understanding or sound judgment in such a movement. The idea, or the combination of such factors as may exist is one of unity—simple harmony, the very meaning of the term signifies accord, oneness.

It was a unionist that had the first idea of our own United States; and other unionists brought the idea into realization. Our great country was formed and furthered by nothing more nor less than the idealistic principle which is and has always been beneath trade-unionism.

It is ridiculous for any man to make the direct statement that he does not believe in unionism, that he does not believe in organization of diversified interests for the betterment of a common cause. Through misconstruction, lack of knowledge, or just plain ordinary egotism men, who may or may not be employers, and who seem determined to apply obsolete and inefficient methods in the carrying on of their lines of endeavor or thought, still try to convince the public that such an idea as unionism is wrong from *A* to *Z*. The truth of the matter is that in many instances these selfsame individuals are members, active or otherwise, of various organizations which really have the same original ideas of unity that is included in the category of the trade-union.

Without taking time to attempt to verify my statement. I believe that such a movement as trade-unionism would never have taken place had the employers realized that eventually they would be compelled to learn what the relationships of human beings amounted to in the conduct of their daily and business existence. I do not believe that there would ever have been such a thing as the phrase, "Capital and Labor" if employers had considered all men equal and had foreseen that human beings could not be bartered nor controlled as the horse and mule. One cannot exist without the other—both sides know it. Today these two —Capital and Labor—are the pillars of the industrial world. We must use both to get where we hope to go.

Our President's Great Faith

It is our good President's faith that we admire. Whether we are an employer or a worker we know he believes in us, in our real aims and ideas, and that he is with us in spirit and deed. Faith and the opportunity to do are here now; we are in deadly earnest that the world shall have and enjoy democracy and fair dealing forevermore.

We all differ in policy to a certain extent, but we do not differ as to faith. The great majority, whether trade-unionistic or otherwise, know that commercial, industrial and big business men, not the grafting politicians, can and will combine forces and win the war. And we know also that sincere, honest business men can combine forces with those who are students of political economy, and with no other than altruistic ideas as their guide carry on successfully. Why? Just because of the faith in the idea that there should be no dividing line in the Golden Rule, and that "all men are equal."

What is the everyday grievance of the trade-unionist? The question is best answered, I think, as simply: "Conditions, working and living conditions." The person who lives as the result of physical effort expects and requires food, shelter and clothing and just a little something besides for the inevitable rainy day. It is the easiest task in the world to satisfy such desires. Ask any employer and he will agree that such would not be hard to meet, if the worker himself would produce. Of course, I do not mean the employer who cuts the price when the worker shows an increase. Thank God, such men are getting scarcer every day.

The Strike Weapon Destroys Unity

It is the weapon of the present day trade-unionist that we despise, and I believe the majority of trade-unionist feel the same way. The only reason that it is a part of the ritual of trade-unionism is because of the effect that it has had, the ready proof of which is always the appeal of the professional union leader. It is apparent, too, that the use of the strike weapon has also proven to the labor leader that anything that will decrease production, such as the shorter working day, the limited production of individual workers on specified jobs, the equality of workers without consideration as to individual production, and the general recognition of the union, is distinctly advantageous to the cause of trade unionism.

Right here is where trade-unionism is wrong, always was wrong, and always will be so long as it holds up the standard that "might be right."

Unity is knocked in a cocked hat when a strike is taken into consideration. A strike is about the farthest thing from harmony that can be imagined, yet it remains the one big feature of unionism as it is being practiced by the trades. If this is true, is there any reason why anbody, any employer, manufacturer, merchant or person in any walk of life should not question the purpose of present day conditions in labor? It is apparently the correct thing to call a strike in almost any industry, but very wrong to stop it unless the employer acquiesces to all the demands made.

Whether men or women belong to a labor union or not, the majority want to produce, they want to do all they can for their land and the world at large. There is not a man, woman nor child who wants to do otherwise if of just ordinary mentality—there is not a doubt in the world of all this—we all want to help. But the radical labor leader, the fellow who is living as a result of agitation, through the muscular efforts of trade unionists, and through the threat of a strike, is making exorbitant demands continuously. He is preaching that the strike is a good weapon—and is holding up production by causing strikes unless the employer quickly concurs with his ideas of hours, wages, who may be employed on the job, etc.

A few friends, possessed of a depraved mind, planned and formulated a damnable system that worked, and the Central Powers are the result. The Teutonic people are mad in word and deed, and will be brought to a normal mental conditions only through cold steel and hot lead. Life, effort, money, faith are going to change all this and bring the insane war leaders to their knees. Germany called a strike—the biggest in history; she split the unity of purpose; she forgot how to associate correctly. The Central Powers made exorbitant demands that will never be met. The Union, our Union, the United States of America, has determined that shall be so.

Private Interests Must Step Aside

The majority of workers do not concur with the union leaders who are furthering ideas that hold up production, who preach in favor of the strike. If these leaders are furthering their present day efforts for no other purpose than to gain power, if they are organizing and gaining new members to the fold for the purpose of forcing exorbitant demands through the use of a strike, through decreasing the production of industry and through taking away the zeal and happiness that comes from trying to earn more by doing more, they—the union leaders—are simply following the path of that King of Hades, Kaiser Bill, and are playing a losing game. It won't work.

Did you ever stop and think what would happen to labor leaders if within the next 24 hours every possible demand could be met and then an additional 50 per cent. thrown in for good measure? Would the labor leader be satisfied? Would he still have a job where the living is pretty good and the physical effort small? Would the trade-unionist continue to belong to the union?

On the other hand, would not these same radical, foolish labor leaders continue to tell their following that there was still something more to strike for, something more that they could get by threatening?

If these labor leaders are sincere, if they are patriotic, why should they not combine with the employers throughout the land and go into the shops along with their unionistic followers and preach production first, last and all the time. If these individuals can be so successful in holding up production, why not use them as builders instead of destroyers. Then would individual production go back to normal and labor turnover take a turn toward the proper amount.

Coal Storage in Large Quantities

Methods, Equipment and Typical Installations

By Henry J. Edsall

Everyone realizes the need of storing coal during the summer and fall for the needs of the winter months. So this article is devoted to the problems of storing large quantities of both anthracite and bituminous, showing in detail methods, machinery, diagrams of arrangements of trackage and piles, and views of a variety of installations.

Mr. Henry J. Edsall *after completing his engineering education entered the engine erecting shops at Cramp's shipyards. After nine months in that position he spent about one and one-half years in several drafting rooms and finally entered the employ of the Link-Belt Company as draftsman. Two years later he went to the New York office as estimator and salesman and after three years returned to the Philadelphia office and is now in the contract department.*

SINCE a great deal more coal is consumed in winter than in summer it is necessary to keep the output of the mines fairly constant, to store a certain percentage of the winter suply during the summer and fall months. The greater difficulties of transportation in winter also make it advisable to handle as much as possible of the winter supply during the months of good weather and to store as near the points of consumption as feasible.

As regards domestic coal the householders help largely in the solution of the problem by storing quite a large part of the winter supply in the spring and summer months. To the average individual the next in importance to the domestic supply is that for water works, gas and electric plants and transportation companies. Since these public panies are among the largest consumers, and since their continuous operation is of such especial importance to the public and, retroactively, to themselves, the insuring of an ample supply of coal for all emergencies is imperative. That this fact is quite generally appreciated is shown by the almost universal provision of storage facilities which, in many cases, are generous in size and of good design, but in others are inadequate for the requirements.

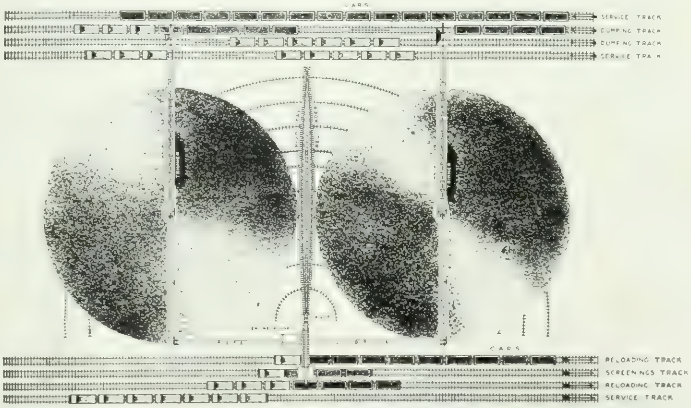


FIG. 1. DIAGRAM OF DODGE ANTHRACITE COAL STORAGE UNIT

In the manufacturing industries the requirements vary largely according to the amount of activity, and, since activity in one industry usually induces activity in other industries, the demand varies decidedly at different times. While the importance of continuous operation may not, as a rule, be as great as with a public service corporation, still a closing down, even for a short time, is apt to be an expensive experience, and to work hardship on employees and clients. In addition to this, any great increase in the demand for coal means that consumers bid against each other for the limited supply and prices go skyward, so that the cost may be two or three times as great as it would have been necessary to pay if there had been proper storage facilities. An ample coal supply is, therefore, a good investment and most modern plants of any size have shown foresight in this respect and are well equipped for taking care of it.

Kind of Coal Is First Question in Selecting Equipment

The first thing to be considered in selecting a coal handling equipment is the kind of coal to be stored, whether, if it is bituminous coal, it is to be crushed, and, if so, whether the crushing is to be done before storing or when it is reclaimed for use. If it is to be stored crushed, the crushing can be done at the point where it is unloaded and before it is distributed to the storage. It is then ready for immediate use and can be reclaimed from any point of the reserve storage and sent directly to the points of consumption.

If, on the other hand, it is desired to store it as run-of-mine and crush it just before it is used it is necessary to collect it from storage and pass it through a crusher before it is sent to the consuming units.

Where small anthracite steam coal is used, or where the bituminous coal is purchased already screened to the proper size, the necessity for crushing is, of course, eliminated. The advisability of storing bituminous coal before or after crushing is still under discussion, but the arguments in favor of storing it after it is crushed seem more logical than the arguments on the other side, since the large lumps tend to form air pockets which give a better supply of oxygen for the adjacent particles of coal. This is especially objectionable if there is a large percentage of fine coal along with the lumps, since this tends to cause heating which increases the oxidizing effect until spontaneous combustion results. The truth of this has apparently been proved quite conclusively in some cases where direct comparison was possible.

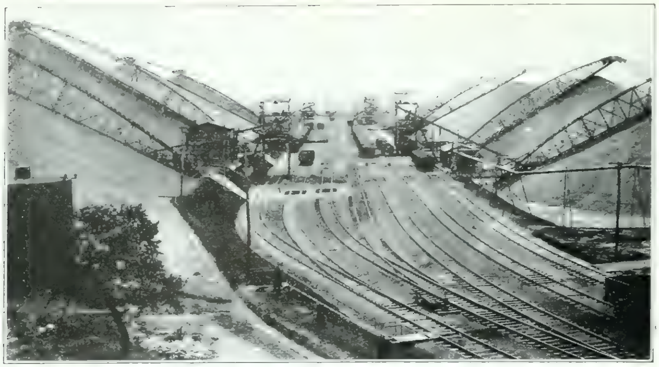


FIG. 2. 480,000-TON DODGE ANTHRACITE COAL STORAGE PLANT
Philadelphia & Reading Coal and Iron Company, Bridgeport, Penn

In coal stored in the open the sulphur content seems to have an important effect in the tendency to heat, as any moisture present tends to combine with the sulphur. It has been suggested in some cases that only lump coal be stored in the open, the fine coal being screened out and consumed at once. This would get rid of the fine particles which offer the greater amount of surface for oxidization and the elimination of which would reduce the liability to heating.

The depth to which bituminous coal can be stored in the open is another point that is open to discussion and varies greatly with the variety of coal to be stored. Fires occur occasionally in very shallow piles but the usual practice is to store it from 15 to 25 feet deep and, where large amounts are stored, to arrange so that if a fire does occur, the coal at this point can be rapidly moved by mechanical means, spread out, and the fire quenched.

Where the coal is to be used for a boiler house the usual practice is to store a certain amount of it, say several days' supply, in an overhead bin so that it can be delivered by gravity to the stoker hoppers, or to larries or traveling weighing hoppers and thence to the stokers, and to arrange a reserve supply in an outside storage as convenient to the power plant as possible, with mechanical means to move it from the reserve to the active storage without going to too great an expense for the transfer equipment.

Where coal is received by rail it is usually dumped through the bottom doors of the cars underneath a trestle, or into a pit, and then distributed over a larger storage area by mechanical means. Where a trestle is used the method of spreading it out over the storage area is ordinarily an automatic grab bucket operated by a locomotive crane or bridge tramway. The same equipment can then be used to reclaim it from the storage area. Where the coal is dumped from the cars into a pit, a similar type of equipment is frequently used to pick it up out of the pit and spread it over the storage area, or it can be fed to a conveyor system that will distribute it or pile it so that it can be conveniently distributed by a grab bucket equipment. Sometimes a conveyor equipment is arranged so that the return run comes back in a tunnel underneath the pile so that the stored coal can be fed back through gates to this

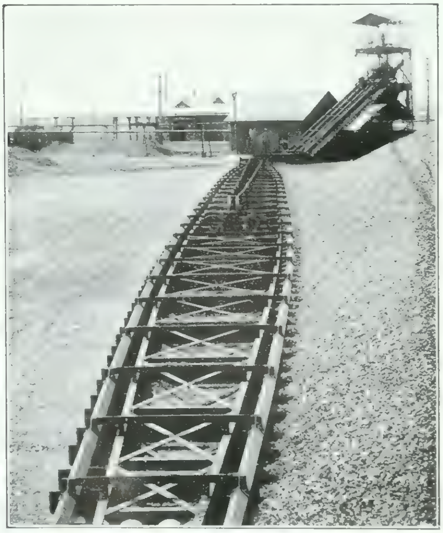


FIG. 3. DODGE RELOADER FOR ANTHRACITE COAL

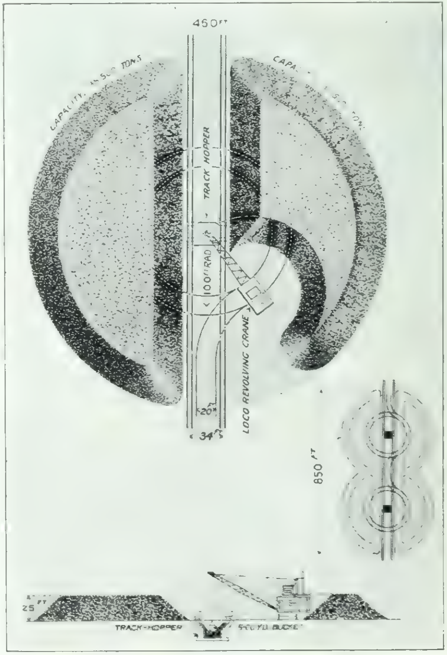


FIG. 4. DIAGRAM OF CIRCULAR STORAGE SYSTEM WITH LOCOMOTIVE CRANE

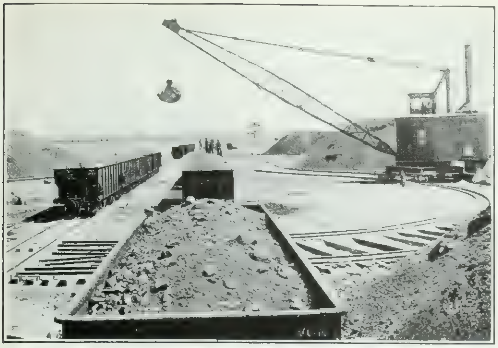


FIG. 5. 100,000-TON CIRCULAR STORAGE PLANT
GULF SMOKELESS COAL COMPANY
Sewell's Point, Virginia

lower run, or a separate conveyor is installed in a tunnel underneath the pile to be used for reclaiming purposes.

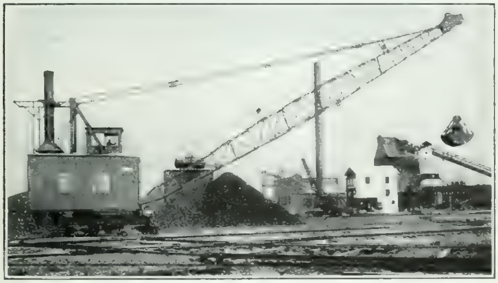


FIG. 6. 100-FOOT RADIUS, 20-FOOT GAUGE, CIRCULAR STORAGE CRANE EQUIPPED WITH 3½-TON BUCKET
Laclede Gas Light Company, St. Louis, Mo.

When coal is received by water, it is a case of unloading it by picking it up out of the boat and the almost universal practice is to pick it up with a grab bucket operated by a mast and gaff, locomotive crane, unloading tower or bridge tramway. Where it is unloaded at a power station it is sometimes elevated to the top of the bin in the grab bucket, passed through a crusher and then delivered to a distributing system over the bin. In other cases, it is elevated only a short distance by the bucket, then, after passing through a crusher, it is fed to conveyors which elevate it and distribute it in the bins. Where it is to be delivered to a reserve storage plant in the open it can be handled back and forth by a grab bucket equipment, a conveyor equipment or a combination of the two arrangements.

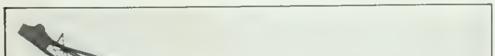


FIG. 7. 110-FOOT RADIUS, 20-FOOT GAUGE, ELECTRIC CRANE FOR CIRCULAR COAL AND COKE STORAGE
Northwestern Fuel Company, Milwaukee, Wis.

STORAGE PLANTS FOR SIZED ANTHRACITE COAL

For large storage plants for sized anthracite coal the Dodge system is very frequently employed. This is a conveyor system with the conveyors arranged as shown in Figures 1 and 2. The coal is piled in large conical piles containing usually 30,000 to 60,000 tons each. Two piles, with two delivery conveyors and one reclaiming conveyor form a unit and all of the conveyors are of the chain and flight type. Each delivery conveyor is set at an incline of 27 degrees, the angle of rest of the coal pile, and a pair of light trusses, connected together just above the peak of the pile, is used to support each conveyor, the conveyor using only one truss and the other one being used to complete the triangle that makes the trusses self-supporting.

The coal is dumped throughout the bottom doors of the cars into a track hopper and fed to the delivery conveyor which discharges it to the pile. To avoid dropping the coal any distance and causing breakage the pile is started at the lower end of the conveyor and close to the ground and, as it increases in height, the discharge point is moved up the conveyor by pulling up a steel ribbon which forms the bottom of the conveyor trough and which is unwound from a drum at the foot. The reclaiming conveyors are reversible flight conveyors with chains and wheels set in a horizontal instead of a vertical plane and each conveyor is pivoted and supported on circular tracks at the ground level. The pivot point is back near the railroad track, and just back of this point the conveyor goes up an incline so that the coal can be delivered over screen chutes back into the railroad cars. The swinging of the conveyor is accomplished by steel cables that extend from the pivot point out to the front end and then to each side of the storage area and dead ended so that the conveyor can be moved in either direction. The outside of the conveyor trough on both sides is left open so that when the conveyor is started and swung against either pile of coal the flights get behind the coal and push it along the trough and up the incline to the point where it discharges over the screen chutes to the cars. Figure 3, on the opposite page, shows a reclaiming conveyor in operation.

BITUMINOUS COAL STORAGE

A system that has become popular for storing soft coal in large amounts is the circular storage system using a large radius locomotive crane equipped with a good sized grab-bucket. This system is shown in Figure 4. The coal is discharged from railroad cars to a central point which is also the centre of a circular track system for the crane to operate upon, the radius of the circle being the same as the operating point on the circular track. The bucket picks up the coal from the dumping point when standing at any point on the circular track. The bucket picks up the coal and by swinging the boom it can be deposited at any point inside the circular track, or at any point outside the circular track so far as the boom can reach. The illustration shows a 100-foot radius

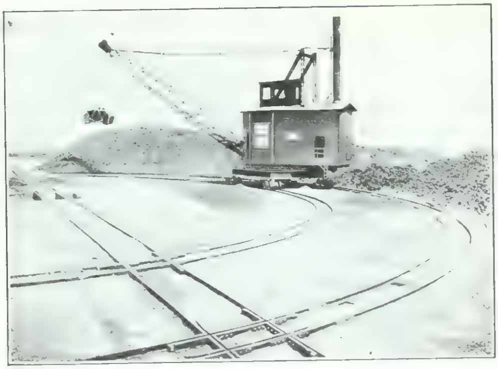


FIG. 8. 80,000 TON CIRCULAR STORAGE PLANT WITH 80-FOOT RADIUS CRANE AND 2-TON BUCKET
Michigan Alkali Company, Wyandotte, Mich.

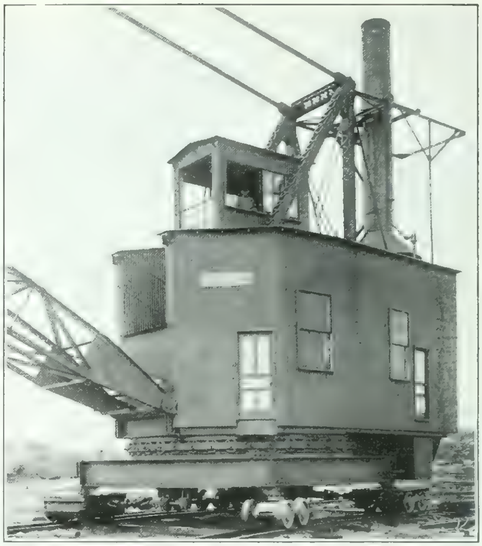


FIG. 9. CLOSE VIEW OF LARGE RADIUS CRANE

crane handling coal from a dumping pit between two railroad tracks, and by piling it 25 feet deep a total storage capacity of 70,000 tons can be obtained if the crane tracks are finally covered up as the crane forms the pile. With past experience to go by, however, it is not considered good practice to cover up the crane tracks, since it is very desirable that the crane should be able to move around these tracks at all times and be able to reach any point of the pile in case of fire. By digging out the coal at the point where the fire starts, it can be effectively overcome with little labor or expense, but without the possibility of digging it out in this manner fire may become quite a serious and expensive menace.

By continuing the track system and forming more loops, a succession of storage piles can be made by a single crane so that the amount of storage obtainable is limited only by the size of the property. When reloading, the coal is picked up from the storage pile by the bucket and loaded directly into cars or hoppers for feeding conveyor systems or sometimes into an overhead bin for coaling locomotives or for delivering to larries or cars running underneath the bin.

Standard circular storage plants storing run-of-mine bituminous coal are shown in Figures 5 to 8, inclusive. Figure 9 shows a closer view of one of the large radius cranes, and Figure 10 shows a five-yard grab-bucket digging out of a pit between two railroad tracks.

BOILER PLANTS AND STORAGE

Figure 11 shows a design of a boiler room with about 50,000 hp. of boilers normal rating and a semi-circular reserve storage plant of about 55,000 tons capacity directly adjacent to the boiler room. While 50,000 hp. is the normal rating of the boilers they might be operated at twice this amount and the total daily coal consumption might run up to about 3,000 tons per day. As a rule, however, the daily consumption would probably not be over 2,000 tons at the most and the conveyor equipment is designed with two duplicate systems each having a capacity of 150 tons per hour or 300 tons per hour total.

The coal cars come in on two railroad tracks and there are two sets of track hoppers quite widely separated so as to give considerable room for shifting cars in between the two sets of hoppers. This arrangement allows four cars to be unloaded at one time, thus making it easy to unload the coal at the desired rate. Underneath each set of track hoppers there are two double reciprocating feeders, that is, one under each track, each double feeder delivering to an apron conveyor running over to one side and delivering the coal to a crusher. After passing through the crusher the coal goes into an inclined flight conveyor of the double strand roller chain type with 24 x 12-inch flights, the flight conveyors from either side delivering at the upper end to two other flight conveyors running at right angles to the tracks and discharging into the overhead coal bins. The overhead bins are located between the two sections of the boiler house and underneath the bins there are larry tracks running to both sides so that the coal can be drawn out of the bins into the larries, run into the boiler room and delivered to the stoker magazines. The center bin of 800 tons capacity delivers to two larry tracks for a double firing aisle with boil-

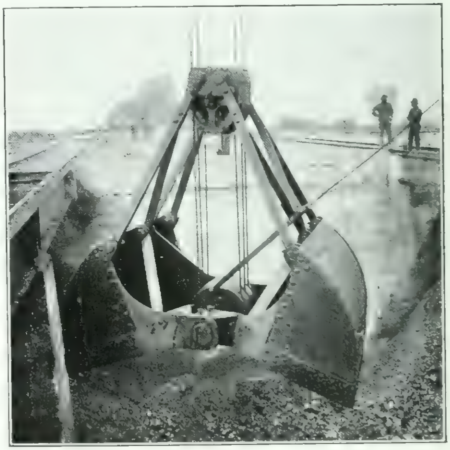


FIG. 10. FIVE-YARD BUCKET DIGGING OUT OF PIT BETWEEN RAILROAD TRACKS

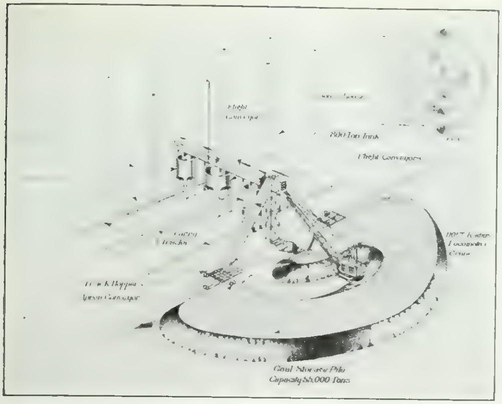


FIG. 11. 55,000-TON SEMI-CIRCULAR STORAGE PLANT ADJACENT TO POWER PLANT WITH CONVEYOR SYSTEM FOR DELIVERING TO OVERHEAD BINS AND LARRIES FOR TRANSFERRING TO STOKER MAGAZINES

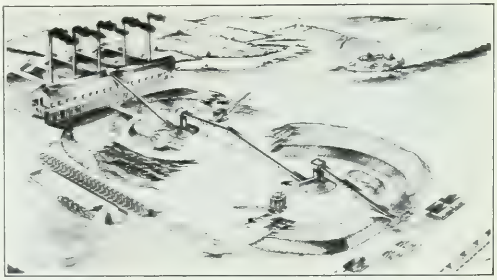


FIG. 13. 100,000-TON CIRCULAR STORAGE PLANT WITH CONVEYOR SYSTEM FOR FORMING DIGGING PILES AND FOR CONVEYING FROM RAILROAD CARS OR STORAGE TO OVERHEAD BIN, AND TWO 110-FOOT RADIUS CRANES EQUIPPED WITH 5½-YARD GRAB BUCKETS

ers on each side and the outside bins, each of 400 tons capacity, deliver to single larry tracks for single firing aisles.

In between the track hoppers the railroad tracks are spread to give room for a dumping pit of proper size for digging coal with a five-yard grab bucket. The railroad cars dump their coal into this pit and the locomotive crane digs it out with a grab bucket and spreads it over the storage area. When the coal is to be reclaimed the crane moves around a little to one side or the other so that it can pick up coal from the storage pile and dump it into the track hoppers to be handled through the crushers and delivered by the conveyor system to the overhead bins. This makes a complete equipment, with duplicate conveyors all the way through and with a minimum amount of expense for overhead bin construction since, by placing the bins between the two sections of the boiler room, they are made to do double duty by serving both sides and the length of distributing conveyors over them is reduced to a minimum.

Figure 12 shows a design for a boiler room of about the same size as the one just described, but in this case the overhead bin is extended all along the end of the building and the larries run from under the bin into the firing aisles in one direction only, instead of having the bin in the center with firing aisles on both sides.

In this design there are also double tracks and two pairs of double track hoppers under each track so that four cars can be unloaded at one time, but the track hoppers are all close together. The coal is fed by reciprocating feeders to crushers and then goes to one of the two inclined flight conveyors running at right angles to the track and delivering at the end either to two inclined belt conveyors to the overhead bin, or to conical piles on the ground, from which the coal is picked up by the grab bucket operated by the locomotive crane, and spread over the storage area. It will be noted that by delivering the coal to piles above ground, from which it can be distributed by the crane, the digging pit is eliminated. When the coal is to be reclaimed it is handled by the crane back to a feeding hopper over the foot of the inclined belt conveyors and the inclined machines take it up and deliver it to the distributing belt conveyors which distribute it in the overhead bin.

In Figure 13 is shown the coal handling and storage equipment of the power plant at one of the large powder plants. The power plant is somewhat centrally located among the powder manufacturing

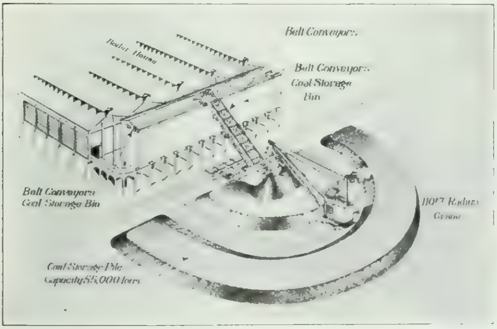


FIG. 12. 55,000-TON SEMI-CIRCULAR STORAGE PLANT ADJACENT TO POWER PLANT AND CONVEYOR SYSTEM FOR FORMING DIGGING PILE FOR GRAB BUCKET AND FOR HANDLING TO OVERHEAD BIN

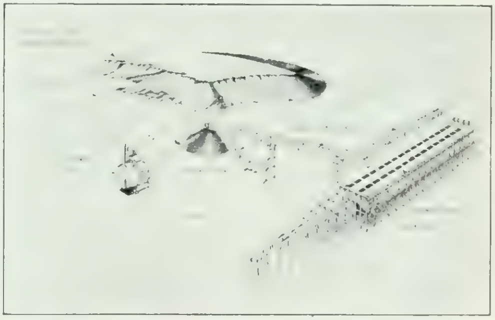


FIG. 14. 120,000-TON CIRCULAR STORAGE PLANT FOR ANTHRACITE STEAM COAL AND CONVEYOR SYSTEM FOR HANDLING FROM RAILROAD CARS OR STORAGE TO LOCOMOTIVE COALING STATION

Delaware & Hudson Co., Oneonta, N. Y.

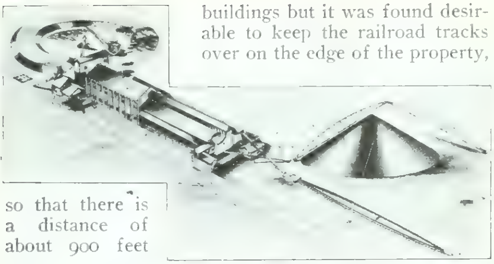


FIG. 15. 50,000-TON CIRCULAR STORAGE PLANT FOR BITUMINOUS COAL AT BRIQUETTE MAKING PLANT AND 60,000 TON DODGE PLANT FOR BRIQUETTES

Virginia Navigation Coal Company, Norfolk, Va.

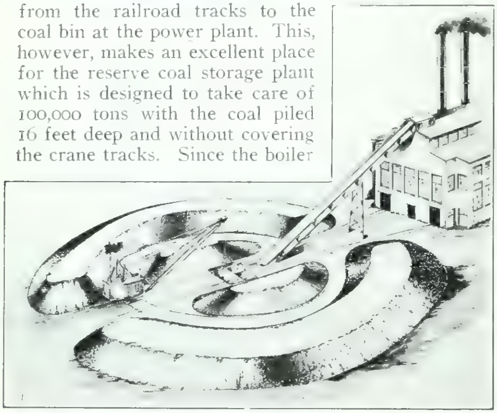


FIG. 16. 50,000-TON CIRCULAR STORAGE PLANT WITH CONVEYOR SYSTEM FOR DELIVERING TO OVERHEAD BINS IN POWER PLANT

buildings but it was found desirable to keep the railroad tracks over on the edge of the property, so that there is a distance of about 900 feet from the railroad tracks to the coal bin at the power plant. This, however, makes an excellent place for the reserve coal storage plant which is designed to take care of 100,000 tons with the coal piled 16 feet deep and without covering the crane tracks. Since the boiler house is still larger than the ones just described and the coal consumption correspondingly greater it was decided to bring the coal trains in on three tracks instead of two. There is a system of belt conveyors running through the center of the coal storage plant and on each side of the center there is a set of track hoppers, each set accommodating four coal cars, so that, if necessary, eight cars can be unloaded at the same time. Underneath each set of track hoppers there are two apron feeders delivering to crushers out at one side of the track, and from the crushers the coal goes to inclined belt conveyors running up to a central point above ground and delivering to the first one of the longitudinal belt conveyors which run over to the power plant. The longitudinal belt conveyors are divided into three units, so as to make two central digging points for the 110-foot radius locomotive cranes, and when the coal is going directly to the overhead bin at the power plant it is discharged from one belt to the next until it reaches the top of the coal bin where it is delivered to the distributing belt conveyors over the bins, of which there are two running in each direction from the central point. When the coal is to be delivered to storage it is discharged at the end of one of the belt conveyors out into the pile alongside of one of the concrete silos, and the cranes dig it up with the grab buckets and distribute it over the storage area. Each concrete silo serves as a support for the head machinery of one belt conveyor and the foot machinery of the next and makes it possible to feed the coal out into the digging pile through an opening in the silo and, when it is being reclaimed, through another opening to a feeder which delivers it to the foot of the next belt conveyor. There is a duplicate system of belt conveyors all the way through, each system having a capacity of 300 tons per hour. The crushers have a capacity of 150 tons per hour each. The 110-foot radius locomotive cranes are equipped with 5½-yard buckets and are each capable of handling 200 tons of coal per hour and more under favorable conditions as regards location, etc.

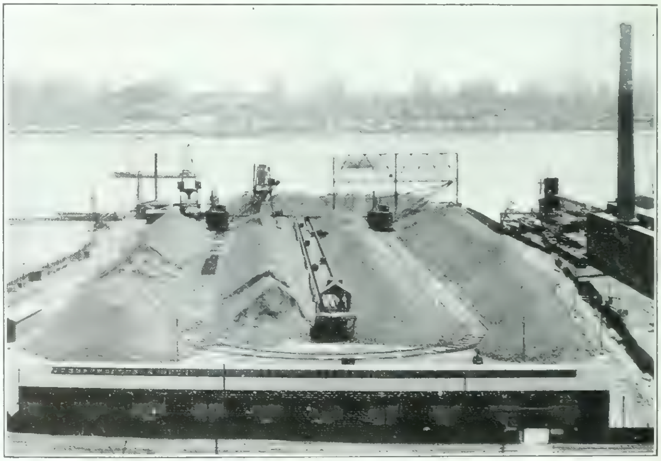


FIG. 17. 225,000-TON BITUMINOUS COAL STORAGE PLANT WITH TWO 100-FOOT RADIUS CRANES EQUIPPED WITH $3\frac{1}{2}$-TON GRAB BUCKETS AND CABLE RAILWAY FOR HANDLING BETWEEN BOATS AND STORAGE

A LARGE ANTHRACITE STORAGE PLANT

In some cases a large radius locomotive crane, equipped with a grab bucket, makes an excellent machine for storing anthracite steam coal. An installation of this kind is shown in Figure 14, this being a plant operated by the Delaware & Hudson Company at Oneonta, N. Y., which is used in connection with a locomotive coaling station. The coal is dropped from the cars into a track hopper and handled by conveyors to a central digging point for the locomotive crane bucket. A pile on the ground is formed at this point so that the coal can be picked up by the bucket and distributed by swinging the boom of the crane. As there is practically no danger of fire with this coal, it can be piled deep and the crane tracks can be covered. The depth of the pile in this case is 50 feet and a large amount of storage can be obtained for the amount of area covered. There are two sets of circular crane tracks, one with a radius of 110 feet from the center of the digging pile so that the crane can reach this pile from any point on the

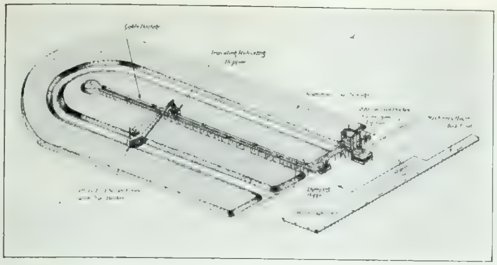


FIG. 18 100,000-TON BITUMINOUS COAL STORAGE PLANT WITH 110-FOOT RADIUS CRANE AND CONVEYOR AND CABLE RAILWAY SYSTEM FOR HANDLING FROM BOATS OR STORAGE TO RAILROAD CARS

American Brass Company, Bridgeport, Conn.

circle, and the other at a radius of 100 feet greater so that when the outside pile is to be filled up the crane moves around to the outside track and rehandles the coal out into the outside part of the storage. This makes two handlings of the coal for this part of the storage, but as long as the daily requirements are not too great, it is just as well to have the crane in almost constant operation as to have it idle, and this rehandling of the coal avoids the necessity of greater expense for additional equipment.

When the coal is loaded it is reclaimed by the bucket and delivered to a loading hopper on a tower at the center of the digging pile, or just about at the center. From this hopper it is fed to an inclined flight conveyor which takes it across a bridge over a number of railroad tracks to the coaling station, where it is delivered to a distributing flight conveyor running at right angles along the length of the pocket.

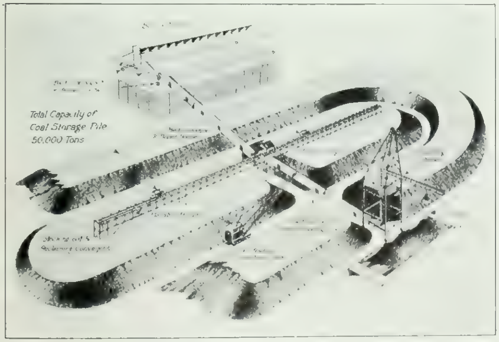


FIG. 19. 50,000-TON BITUMINOUS COAL STORAGE PLANT WITH UNLOADING TOWER FOR HANDLING FROM BOATS, CONVEYOR SYSTEM FOR DELIVERING TO OVERHEAD BIN IN POWER PLANT, OR TO STORAGE, AND 65-FOOT RADIUS CRANE EQUIPPED WITH 2 YARD GRAB BUCKET FOR RECLAIMING FROM STORAGE AND RETURNING TO CONVEYOR SYSTEM

This distributing conveyor has gates and chutes for delivering the coal to the various bins from which it is discharged over chutes to the locomotive tenders. The flight conveyors run at a speed of 150 feet per minute and have a capacity of 200 tons per hour. The total amount of storage obtainable with the locomotive crane and track system shown is 125,000 tons.

Figure 15 shows a 50,000-ton bituminous coal storage at one end of a large briquette-making plant, and a 60,000-ton Dodge storage plant for the finished briquettes at the other end of the plant. Since it is only the small sized coal that is used for making the briquettes, the large coal is first screened out and reloaded to railroad cars, the screening and loading being accomplished by means of a tipple equipment with shaking screens and loading booms. At the receiving end of the plant the cars are brought in on two railroad tracks which pass over a double track hopper and are then spread out and run under the tipple building. The coal is discharged from the cars into the track hoppers which deliver to an apron conveyor running up between the tracks to the head of the tipple building and delivering to either one of two shaking screens. The lump coal, after passing over the shaking screens, goes to one of the loading booms and is loaded into railroad cars. The coal which goes through the shaking screens goes to a belt conveyor that takes it across to storage building No. 2, where it is delivered, either to a gravity discharge elevator-conveyor equipment for distribution in an overhead bin in building No. 2, or to a 36-inch belt conveyor running at a slight incline to the center of the coal storage space. At the center of this coal storage there is a concrete silo. The coal is discharged from the end of the belt conveyor to a pile outside the silo from which the locomotive crane digs it with a grab bucket and spreads it over the storage area. When the coal is reclaimed it is picked up by the grab bucket and deposited in a pile alongside the silo and from here it flows through an opening in the silo into the foot of a double strand gravity discharge elevator with 30 x 45-inch buckets attached to a double strand of 12-inch pitch steel strap roller chain. This elevator delivers the coal back to the belt conveyor which in turn delivers it to the elevator-conveyor serving the overhead storage bin.

The coal is drawn out from the overhead bin into the briquette making building, mixed with a binder and made into briquettes of a cylindrical form, about 3½ inches diameter by 3½ inches long, and weighing about four ounces each, which are turned out continously at the delivery end of the plant. At this point there is a cross flight conveyor which delivers the briquettes either to the loading booms in building No. 4, for loading into railroad cars, or to the carrying run of the trimmer conveyor which takes them out and up the inclined trimmer truss and delivers them in the usual manner to the storage piler. When the coal is to be reclaimed, the reloader conveys the briquettes back to the foot of an inclined conveyor which discharges at its upper end to the flight conveyor running over to the loading booms of building No. 4. The reloader conveyor has 8 by 18-inch flights attached to a single strand of ⅞ by 12-inch pitch chain. All the above conveyors are designed for a capacity of 200 tons per hour except the apron conveyor which handles the run-of-mine coal from the track hoppers up into the tipple building which is designed for a capacity of 300 tons per hour.

This plant is designed for future extension in the direction away from the railroad track, the storage building at the receiving end and the flight conveyor equipment at the delivery end being designed for extension sufficient for the addition of three briquette making buildings.

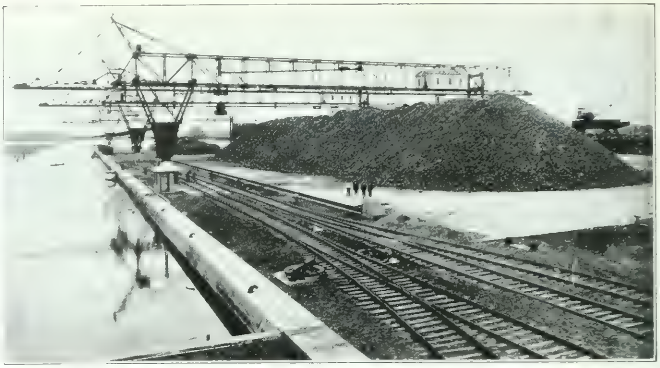


FIG. 20. THREE 360-FOOT SPAN BRIDGE TRAMWAYS EQUIPPED WITH 5½-TON GRAB BUCKETS FOR UNLOADING COAL FROM BOATS AND DELIVERING TO RAILROAD CARS OR TO 500,000-TON STORAGE; AND FOR RECLAIMING FROM STORAGE AND DELIVERING TO CARS

Berwind Fuel Co., Duluth, Minn

Figure 16 shows a design for a 50,000-ton circular crane storage directly in front of the end of a boiler room with an inclined flight conveyor running up to the top of the overhead bin storage in the boiler room. The tracks are set wide enough apart to allow for a grab bucket digging pit between them, and the track hoppers are alongside the digging pit. The coal is handled from the track hoppers by apron feeders to the crushers from which it passes to the inclined flight conveyor discharging at the upper end to the distributing system for distributing in the overhead bins.

After passing over the track hoppers, the tracks are spread still farther so that they go directly into the basement of the boiler room, thus allowing the railroad cars to be run under the ash hoppers so that the ashes can be discharged directly into them.

Figure 17 shows the storage plant of the New York Edison Co., at Shadyside, N. J. It has a storage capacity of 225,000 tons of bituminous coal. The coal is unloaded from boats by means of a hoisting tower equipped with a grab bucket and is delivered to the cars of a cable railway. This cable railway has a long straight run on a trestle through the center of the storage area and the cars dump the coal all along under this trestle. There are two 100-foot radius locomotive cranes equipped with five-yard buckets and after the coal is piled along under the trestle these cranes pick it up and distribute it over the storage area as shown in the picture. Each crane has a capacity of 200 tons per hour and in a recent test each averaged 240 tons per hour for a ten-hour run. When the coal is reclaimed, it is picked up by the crane buckets and delivered to a feeding hopper that can be moved along the cable railway, and is arranged to deliver to the cable cars which take the coal back and deliver it to boats to be taken over to the power plants in New York City.

Figure 18 shows a coal storage plant of one of the large manufacturing companies which is quite similar to the New York Edison Plant except that in this case the crane tracks are run out onto the wharf so that the crane can also be used for unloading coal from the boats. The crane unloads the coal from the boats and discharges it into a receiving hopper which feeds carriers that deliver to an overhead transfer bin. From this bin the coal is either fed to the cable car system for distribution to storage or it is delivered by gravity direct to railroad cars. There is also a coal crushing equipment so that the coal can be stored either as run-of-mine or as crushed coal. It is interesting to note that while there have been fires in the run-of-mine coal there have been no fires in the coal which was stored crushed.

Figure 19 shows a 50,000-ton storage plant for bituminous coal located between a water front and a power house. The coal is unloaded from the boats by means of a grab bucket handled by a hoisting tower, in which there is a crusher, and after it is crushed it goes to an inclined belt conveyor which is supported a little above the ground level. This belt conveyor delivers at the center of the storage pile either to a second inclined belt going up to the top of the overhead bin in the boiler room or to one of the two distributing flight conveyors running lengthwise of the storage pile. It will be seen that coal can be sent direct to the power plant or delivered to the storage pile by means of the flight conveyors. For spreading the coal further in the storage pile there is a 70-foot radius locomotive crane equipped with a two yard bucket. The crane runs on 9-foot gage tracks but otherwise is similar to a standard gage crane and is not much more expensive, so that it is a much cheaper machine than the very long radius cranes described for previous plants.

The coal is spread around in the storage area so as to obtain the 50,000 tons with the pile 15 feet deep. When the coal is to be reloaded for the power plant it is reclaimed by the crane and delivered back to the flight conveyors, which deliver to the inclined belt to the power plant. It will be noticed that the boat unloading tower does not need to be very high, as it lifts the coal only far enough to deliver it to the crusher from which it feeds to the inclined belt conveyor just above the ground level. A low tower of this kind can, of course, be built much lighter and at a great deal less expense than a high tower, and the handling capacity and safety is greater on account of the lower lift of the bucket.

A bridge tramway spanning across a large ground area and having a grab bucket traveling back and forth on it is a method that is used a great deal for handling from boats into a storage pile and reclaiming from the storage pile and delivering either to boats or to railroad cars. This is a more expensive system than some of the others previously described but it fits in admirably under certain conditions in large plants.

Figure 20 shows the plant of the Berwind Fuel Company at Duluth, Minn., where there are three of these bridge tramways each equipped with a 5½-ton bucket operated by wire ropes leading around sheaves on the bridge and controlled by an operator at a fixed point. The total amount of storage obtainable is 500,000 tons.

Salvage at the Winchester Plant

How Scrap and Spare Material to the Annual Value of Millions of Dollars is Reclaimed and Utilized

By Charles M. Horton

The work of reclaiming factory waste is highly organized at the plant of the Winchester Repeating Arms Company and put on a basis of standard practice. The maintenance department is in charge. The classification of salvage operations alone has 140 items, indicating the care with which the various materials are separated and handled.

Mr. Charles M. Horton, *member of The American Society of Mechanical Engineers, was educated in public schools of New York City and at the University of New Mexico. He served a drafting room apprenticeship and had twelve years' experience in designing special machinery. As an avocation he has pursued literary work, writing for both fiction and technical publications.*

THE word "waste" in the industrial world is rapidly becoming obsolete as there is no waste or, rather, manufacturers more and more are turning their attention to the work of salvage with the result that one organization, at least, the Winchester Repeating Arms Company, New Haven, Connecticut, has cut and is cutting waste down to a few scraps. A large part of the waste so salvaged is utilized in the manufacturing operations of the company itself, but the residue which cannot be so utilized is sold to the best advantage in the open market. The value of the salvaged material amounts to several hundred thousand dollars per year.

A department that shows such a saving annually is well worth writing about, and the author of this paper recently looked into the methods in practice there. He found a complete and efficient organization. The thing has been growing for 10 years, having had very small beginnings in a corner of the carpenter shop, where a couple of men were engaged in the work of rejuvenating broken packing cases. Today the salvage shop employs 114 men, supervised by a functional staff of five overseers, and embraces machinery and equipment whose ramifications cover a great number of offices, such as oil extractors, driers, baling machinery, pop-off kettles, oil refiners, sorting machinery, and the like, with eleven wagons collecting miscellaneous waste material preparatory to the work of salvage, and an automobile truck to dispose of by-products that cannot effectively be converted into useful material again—a complete and efficient organization, indeed.

The Winchester Repeating Arms Company is, first, a young man's organization. This is good, and in a way accounts for the remarkable results attained by the staff. Youth succeeds where age—middle age spreads its hands and in wide-eyed doubt declares the scheme impossible of successful attainment. Also, everywhere there is embodied in this executive staff evidences of capable energy. And that also is good since energy and enthusiasm ever ride in the same saddle, and one could indeed feel an atmosphere of enthusiasm for the work already accomplished, and being accomplished every day, in the salvage department.

Yet the methods of attaining the results shown are quite simple—so simple, in fact, as hardly to seem to warrant description. Still, that too is as it should be. Because in the simple things lie true effectiveness and efficiency. A complex system in any branch of any organization begets trouble. Simple machinery, for instance, will require a minimum of supervision, and will fail least in operation. A linotype machine, to name only one type of intricate mechanism, will get out of order more frequently than will a wheelbarrow, to name a popular type of simple mechanism—and the same is true of methods. So the methods in use in the salvage department of the Winchester Repeating Arms Company, being as they are simplicity itself, cast a sort of blazing white light on the maintenance "overhead" sheets when compared with the cost of operation.

PROCESS OF SALVAGE

The process of salvage begins naturally with the work of collecting. Most of the material is gathered up from the floors of the different departments where it lies after falling from the machines. Because of the various grades of steel and brass used in manufacture in the plant, great care is exercised right at the start in keeping the different grades of metals—chips—separate one from another. This is done by means of small cars and trucks, to each of which is attached a heavily marked tag, and into each of which only the fixed grade of chips is emptied and conveyed to the oil extractors and thence to the bins—likewise marked and held separate—out in the salvage yards.

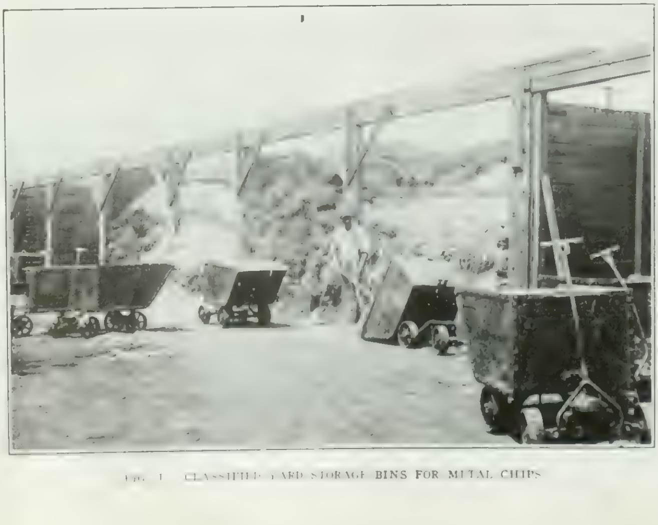


FIG. 1 CLASSIFIED YARD STORAGE BINS FOR METAL CHIPS

The cars are hauled about by means of a small motor tractor capable of quick attachment and detachment, and each car, as I have said, has its own particular grade of material to handle. This is rigidly held to, and is a feature worth bearing in mind and repeating. All scrap originating in the production department shops, as well as those having their origin in the maintenance department shops, the tool department shops, the gage shop, the cartridge shop, and the like, because of the varying character of the metals so gathered, and to facilitate the work of salvage as a whole, are kept each by themselves throughout the process.

The salvaged articles and materials are many, of course. I shall describe the process through which a few of these pass.

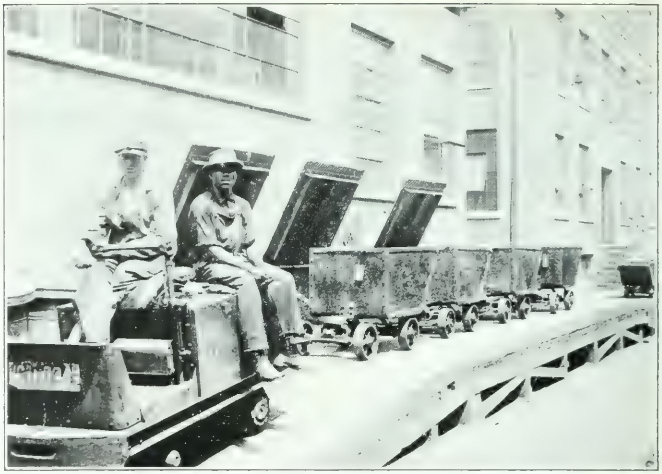


FIG. 2 TRACTOR AND DUMP CARS FOR GATHERING METAL CHIPS

SHOP WASTE

When discarded by mechanics, and as gathered up by the laborers assigned to the work of gathering, the cotton waste is rich in oil and tiny particles of metal, and the department maintains steam kettles or boilers for the purpose of extracting these ingredients and then turning back the waste for use again in the shops. The oil-soaked and metal flecked waste is boiled at a high temperature to free it of oil and metal, and afterward it is placed in driers and subjected to a sort of baking process, from which it emerges in condition to be used over again for the purpose for which it originally was purchased. The oil and metal particles and water resulting from the process and remaining in the steam kettles are each separated one from another—the water through boiling the whole amount, the metal particles through centrifugal machines, and the oil through gravity and drainage. The quantities thus gained more than compensate for the cost of salvaging the waste, besides placing the waste itself back into use again.

The inspection of ammunition is of necessity exceedingly severe and the slightest defects cause rejection. As many of these defects are not apparent until the cartridge is completed, it is necessary that extreme care be taken in the handling of any scrap containing explosives.

Rejected shot shell and the larger calibers of cartridges are sent to a pull down shop where the shot or bullets are extracted, the powder poured out, and the primed shells sent to a small shop known as the pop off shop. The smaller calibers of rejected rim fire cartridges are sent direct to the pop off shop without being pulled down.

To guard against premature explosion in the pop off shop the cartridges are placed in a tank and kept submerged in water until the pop off ovens are in readiness to receive a fresh charge. The pop off oven, as it is called, is a heavily-lidded device exposed to heat and in this the rejected cartridges are placed and, because of the heat, exploded.

The cartridges and cartridge shells beside the explosives are made up of copper, lead and in some cases of cupro nickel bullet covers. In these as in many of the shot shells there is a steel lining inside the brass cup. The heat in the pop off oven melts the lead which is drawn off and poured into molds. The brass, copper and cupro nickel scrap are taken to a scrap inspection department, sorted, passed through a magnetic separator, where all steel is extracted, pressed into "cabbages" by hydraulic pressure and remelted. In such a plant as that of the Winchester Co., this amounts to a very large quantity.

FIG. 3. HOW DIRTY COTTON WASTE IS GATHERED

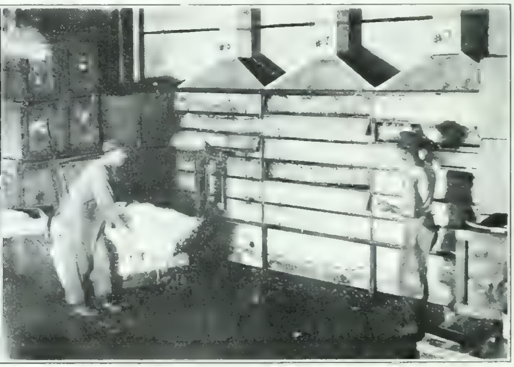


FIG. 4. DRYING OVENS FOR COTTON WASTE

Old Cases and Boxes

Discarded packing cases and boxes formerly were broken up and disposed of as old lumber. Today the boxes are repaired in a small shop set apart for this purpose, by two men who drive nails, and do nothing else, at a very low labor cost. Wooden trays used in the machining departments for holding finished parts, cases which come to the plant around some purchased material, all are sent to this department and either put into shape again for further use, or else, being too badly out of repair for effecting salvaging, are tossed out into a lumber pile, from which, later, the organization manufactures its own sawdust to be used on the floors or else in the tumblers for polishing.

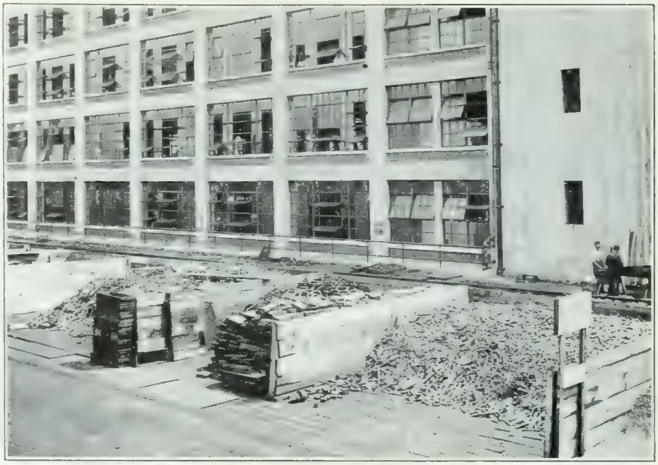


FIG. 5. SALVAGE BINS FOR SCRAP METAL

Bolts, Nuts and Screws

As always happens a miscellaneous lot of bolts, nuts and screws are gathered up in the floor sweepings. These are sent to the salvage department more or less buried in sawdust and the usual accumulation of floor dirt and refuse. Shaking screens, such as are used in the mining industry, separate the nuts, bolts and kindred pieces from the dirt, and afterwards they are dumped out upon sorting tables, where men separate them according to sizes and shapes. They are then conveyed to the general storeroom, placed in the regulation storeroom bins, and so are made instantly available in response to demands from the different production departments, as well as maintenance, and thus are placed back into service again.

Rags and Waste Paper

There is a considerable amount of rags and paper material handled. Torn window shades are seamed over into little handbags wherein such material is carried about the shops. The rags gathered up which offer no further utilization in the organization are baled by presses into compact form and sold in the market. Waste paper is likewise treated—pressed to a solid mass—and also sold to the market, being shipped out at intervals in freight cars on one of the company's private sidings close to the paper-and-rag storeroom sheds. The money savings here are enormous, as may well be surmised, owing to the present high market value of these materials.

Old Powder Cans

Empty powder cans are turned to surprising use? The bottoms are cut off and the cans made to serve as cuspidors in the shops. Spittoons are as necessary to the comfort of workmen as stools, and in this measure the department has inaugurated a useful as well as sanitary economy of no small value at a very low cost. The tops of the powder cans are baled together with other sheet metal scraps gathered in the plant, and disposed of as the nature of the materials themselves will permit; some of this goes to the junk dealer, but most of it is converted back into raw materials for production—notably brass scraps.

Brass Scrap

Brass scrap comes to the salvage department in many shapes and in several grades and mixtures. Each grade is held separate throughout the process of salvaging. Empty cartridge shells, after being separated from the

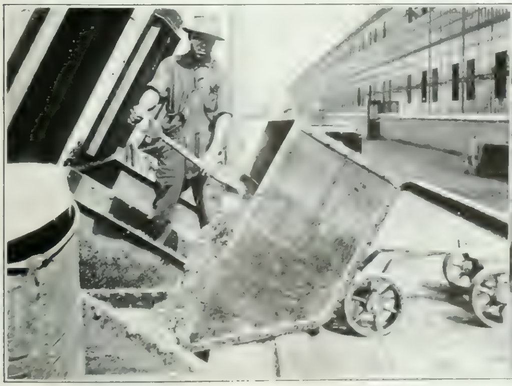


FIG. 6. DUMPING CAR OF [illegible]

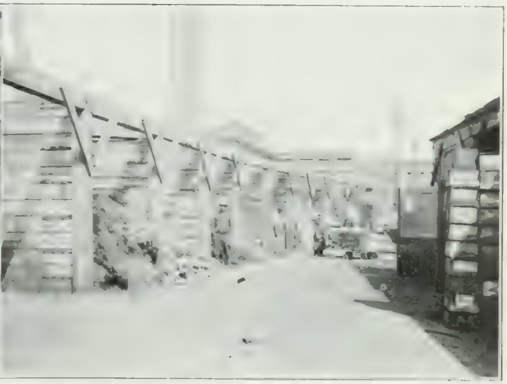


FIG. 7. CLASSIFIED [illegible] BINS FOR SORTED SCRAP

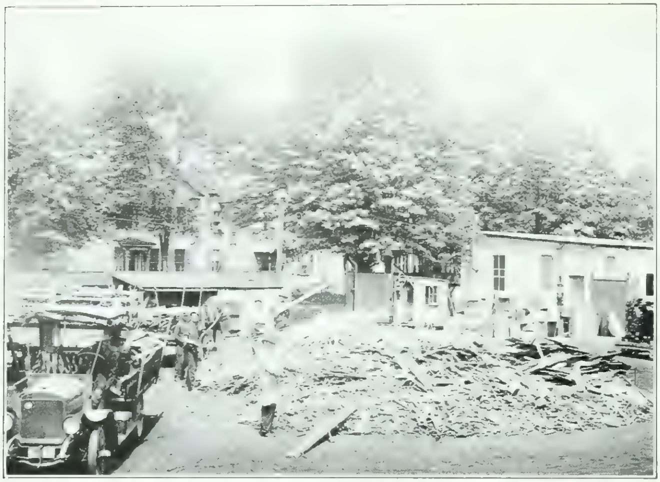


FIG. 8. YARD FOR LUMBER SORTING AND STORAGE

sweepings in which they are gathered by means of shaking screens, are shovelled up into pockets in a powerful hydraulic press, in these pockets there being first placed a sheet of scrap from which punchings have been cut to act as a sort of container, and the whole is pressed into small bales. The bales are then conveyed to crucibles and there the brass is melted down. Brass chips are separated from their oils in centrifugal machines, and likewise baled and melted down. The department given over to this work is of primary importance, and is probably the most active and expensive to operate of any, owing to the character of the product as a whole, utilizing as it does more brass materials than any other kind.

Cutting and Lubicating Oils

Having been separated from the chips and the waste of the shops, the oil is treated in considerable detail. It is first boiled to rid it of remaining water, then drawn off into tanks and again exposed to heat, a process continued until it has been cleaned and refined. To this reclaimed grade is then added a given quantity of new oil, after which it is barrelled and later utilized in the shops, for the most part as a cutting oil in the machine departments. There is a refuse which is made into a kind of "scat," neatly scented, boxed and labelled, which is sold to the workmen at a minimum cost, the proceeds going toward the cost of operating the athletic club, the pride and joy of the plant. One negro boy does the boxing and labelling of the "scat," at a wage, no doubt, that makes the thing pay well. The extracting and refining of oil in the salvage department is evidently the most elaborate of the many processes in use in the work of salvaging materials in this extensive establishment.

Coal and Ashes

The work of separating good coal from ashes and metal scraps from the foundry and furnace slag is in the hands of two laborers. Thes men sort the heap over by hand; they salvage out on an average two tons of coal a day, with a very great additional saving in scraps of metal, and between them earn a remarkable wage for men whose only knowledge of English is "Sure, Mike!" and "Zdamhot!" Their earnings a week average something in the neighborhood of $35, but they earn it in intensive application, and obviously, in the salvaged coal alone at $6 a ton, or thereabouts, the work in this department also is of high value.

The Salvage Storeroom

Much of the material salvaged, such as electric shades, gas fixtures, laborers tools, lighting fixtures, odds and ends of pulleys and sheaves, due to a heavy accumulation of these things, is not instantly usable again in the plant. Because of this, the storeroom is likewise a sort of free salesroom, with the material and parts neatly stacked or suspended from hooks and nails, and where one may go from outside and make selections according to his needs. There is maintained a small selling force whose duty it is to convert the stock on hand into cash at best market prices, and shovels with broken but repaired handles, picks, crowbars, blocks and falls, fuse-plugs, steel and wooden pulleys in great assortment, lengths of shafting, and the like, all may be secured here upon application. In effect, the room looks like a cross between a junk shop and a ship chandler's store with one very agreeable difference, viz., the floor is neatly swept and the material and utensils somehow have a clean, fresh look, as if given considerable attention in the cause of cleanliness and sales-effectiveness.

Material	Unit Cost Per Pound
Copper	0.0006
Rags, waste, etc.	0.005
Metals, miscellaneous	0.0019
Iron	0.0001
Scrap paper	0.0002
Steel	0.0005
Containers, barrels	0.0114 each
Zinc oxide	0.0001
Scrap rubber	0.0018
Wood scrap	4.28 per load
Oil	0.72 per bbl.

Miscellaneous Materials

The insulated wire salvaged in the plant is being considered, and a machine for separating the cloth and rubber from the copper wire is now under construction. The cakings from the interior of the furnace flues are being gathered and dumped into bins and sold for their chemical ingredients. Cast iron scraps are accumulated in one section of the salvage yard and there loaded onto freight cars and shipped to foundry markets in the vicinity. Old and discarded machine tools are thoroughly overhauled and cleaned, and then crated and shipped to recognized second-hand dealers at good prices. Felt, fibre and cloth, as well as leather and hides, are all treated for the oil contained within them, following the usual methods of extraction, and converted back into plant use, or else sold to outside markets, depending upon the character of the materials. Barrels requiring it are recoopered.

All of which, by way of brief review, signifies something. Waste is never waste until it is actually waste. Like the pork packer in Chicago who sold everything but the squeal, the Winchester Repeating Arms Company salvages everything seemingly but the chatter of the machine tools. They may get this in time, and can it for use in moving pictures where realizism is desired in studies of machine shops in operation—who can say?

Beginnings of Labor Maintenance Service in a Small Plant

By Mary L. Morris

How can labor maintenance service be adapted to the needs of small plants is a question concerning which more experience and facts are needed before we can be sure of the answer. The article below is a direct aim for it shows how this form of service was started in a textile mill employing 500 workers. The work was divided into medical, employment and social, and subdivisions were taken up in the order named.

Miss Mary L. Morris *received a normal college education supplemented by special instruction in New York and Paris. She did voluntary work among the poor whites in the south for two years and later was business manager of a girls' school in Paris. For three years she held the position of assistant to the executive secretary of the Board of Recreation of the City of Philadelphia. Then turning to industrial work she was for two years welfare manager of the Curtis Publishing Company, and at present is manager of the service department of the Connecticut Mills Company, Danielson, Connecticut.*

SERVICE WORK IN A SMALL PLANT

At the annual meeting of the National Safety Council in New York in September, 1917, the question was asked by a number of persons, "How can service or labor maintenance work be adapted to the needs of a small plant?" After a year of starting and directing this work in a mill of 500 employees, I offer the following summary of my experiences to answer this question:

For two years I directed the welfare department of an establishment of 3500 employees, where I had 10 assistants. Everything ran on a well-ordered plan, the whole plant was the last word in efficiency, equipment and management, which left so little room for creative work that I felt a need of starting the work in a new field.

To begin with, the mill where I now am is in a small New England village. Among the 500 employees are Americans, English, Irish, French, Italians, Greeks, Poles, Prussians, Syrians, Portuguese, Negroes and French Canadians. The mill is a cotton textile mill with no occupational disease and very few hazards; the light and ventilation are good and the sanitary conditions are right. The machinery is well guarded.

When I arrived, I found the plant run on the old-fashioned conventional plan, the "super" doing most of the hiring, and the overseers firing *ad libitum.* No one had any knowledge of employment, or labor maintenance work, but there was an antagonism on general principles, as the department had been created by vote of the absentee directors.

I divided the work into three divisions, employment, medical and social service. It was unwise to begin with employment, owing to the lack of understanding, on the part of the overseers. It seemed best to try the medical end as an entering wedge, so I chose the best lighted and quietest room in the mill, and put carpenters and painters at work. A model first-aid room was the result.

BEGINNING MEDICAL WORK

Meanwhile I established a first-aid dressing station in a corner of the cloth-room, and when I was not making friends with the overseers and studying working conditions, I made first-aid dressing and friends along with the dressings. A number of infected cases began to arrive, and I had my hands full trying to undo the harm caused by lack of treatment. The employees dubbed me "the nurse," by which title I am still known to most of them. By the time the hospital was ready to be opened the mill had joined the National Safety Council. Bulletin boards had been placed in every department, and the excellent bulletins furnished by the Council had begun to show results, for the employees came to the hospital with small, fresh cuts and scratches, instead of waiting until infection developed. They brought their small ailments as well.

It soon seemed advisable to have a doctor to whom we could refer the cases needing expert medical attention. As more than half of the employees are French-Canadians, and there was a good French doctor in the village, we engaged him for one month to alternate the next month with an American doctor, who was also the village oculist and had his own following as well as the Frenchman. These men now hold a clinic three mornings a week at regular hours in the first-aid room, and in a surprisingly short time the average number of patients has risen to about ten.

There shortly arose the question of an assistant. I interviewed a number of trained nurses to find one to take charge of the hospital work, but was unable to discover a woman with the personality I desired. I consider personality equally important as the ability to bandage a finger skillfully, or to know when to administer a dose of salts. After interviewing a number of women I found a college graduate such as I desired. She also had more than first-aid training and some knowledge of mill work gathered in industrial research.

With the arrival of an assistant in the fourth month of the work, we began to keep records in earnest. The hospital records later have proved valuable in compensation cases and in helping the doctors check up on each patient's medical history from his first visit to us. Not being trained nurses, has, in a way, really helped us at times; a large number of persons have come for some simple dose which we have not hesitated to administer, and which a trained nurse would be unable to give without a doctor's order. In most cases the worker, therefore, loses but a few minutes from work instead of going home for the day. We have more and more accident cases where merely preventive treatment is necessary, and in any case, our accidents are rarely serious; at first we had to treat many infections but these cases are now reduced to a minimum. The ones that we do have are ones who wait until the second day after the injury to come to the hospital, or where the first-aid dressing has been carefully removed and a soap or tobacco poultice substituted for iodine or chlorazene.

We keep also careful record of follow up dressings to be certain that bandages have not been removed and that healing is progressing normally.

In our records we divide all accidents into major and minor, as to whether they need curative or merely preventive treatment. The medical work is largely preventive. We are firm believers in the Chinese medical system of keeping your patients well. The workers rarely lose much time when the trouble is incipient though, of course, we also treat cases of chronic trouble which developed long before the department was started. The hospital records show us causes of ill-health and of accidents; they pit the accident record of one department against that of another, and also show clearly that more men have accidents, while more women come to us for medical treatment. The tabulated report of these records has several times been used as the basis of recommendations to the management, and has always been received with good grace.

The charts made from our weekly accident sheet, which we keep daily, show how the fatigue element operates to bring about more accidents at the end of the week than at the beginning. Saturday being a half holiday in the plant, accounts for the lower point on that day, but were the corresponding five afternoon hours worked as on the other days, the resulting point would be higher than on any other day.

Investigation of Absentees

Our records have not been confined to hospital cases, however. The overseers generally sent us reports of absentees from their departments, especially when they wanted us to look up a particular employee. But as we wished to get at the human side of the plant, and a personal home visit seemed the best approach after the patient had been to the first-aid room, we felt that we must have a daily and an accurate record of employees not at work.

Each overseer had for years prepared for the manager a daily report of idle machines in his department, and the reason for lack of use. We asked that they add to this report the name of the person who should be running this machine, if he were absent, and send us the report first. This was comparaively easy, and now all the reports from the overseers come first to our department, the names of the absentees are transcribed, the report O. K'ed, and then sent to the manager.

From these reports we compile a list by departments of all employees who are absent, who are transferred to another department, or who are leaving our employ. This list is kept on a form devised for the purpose, bearing columns headed "Name," "Department," "Days Out," "Reason Given," and "Remarks," which enables us to see at a glance in which room there is the most irregularity of attendance, and what causes it. As the daily number of absences rarely exceeds 30, it is no great task to keep this record.

A tabulation of findings at the end of the first quarter showed some interesting data. From the total possible attendance in the three months we found that there were 24.1 per cent. of absences due to all causes—"No Work" being given as the chief cause, and sickness of self or family next in line. It has been the policy to call on an employee absent as much as two days, where we were uncertain as to the cause of absence. Therefore these causes which have been checked up are, if anything, conservative. Due to the limited number in the department some of the "unknown" causes could not be ascertained.

Compensation Work

In November the compensation work of the mill was turned over to us, and we were held responsible for the accident blanks, medical certificates and examinations and correspondence that this entails. Partly to have at hand a record of past wages, and partly to have on hand an individual absence record as well as a departmental one, we worked out a card for each employee. These cards contain brief information as to occupation and length of employement, and on the lower half 12 columns of five spaces each, in which to indicate each weekly payment on the payroll. On this card we account for a wage lower than the average—and whether the firm or the employee is responsible for the decrease in output.

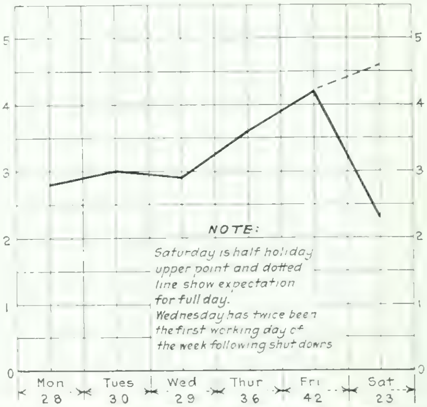


CHART 1. AVERAGE NUMBER OF ACCIDENTS PER DAY FOR 20 WEEKS

These cards can also be used in checking up an overseer who wants to replace a worker by a "steadier" employee from another department.

In connection with the hospital work it became customary for the overseers to send us employees who wished to go home, alleging sickness as an excuse. From that beginning it was not hard to persuade the superintendant that this department had more time than the busy overseers to interview also the employees leaving the mill. Then for the first time, we really felt that we had our hands on the employment end of the work. The men and women bring us their "time" or "bill," which must receive our O. K. or the money may not be paid out by the paymaster's office.

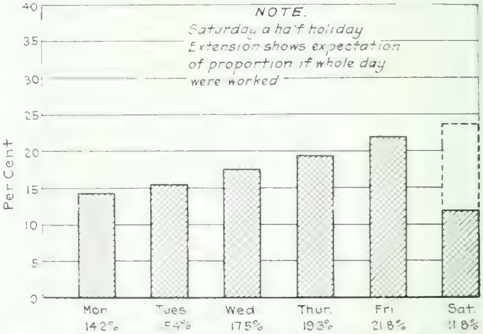


CHART 2. PERCENTAGE OF TOTAL NUMBER OF ACCIDENTS ON EACH DAY OF THE WEEK, SEPTEMBER 1, 1917-JANUARY 18, 1918

Labor Turnover Records

For the past three or four months we have made use of Messrs. Fisk and Gardner's Turnover Record Sheets, posting this daily from the overseer's records. This has confirmed our unofficial knowledge of the large number of departures, and has given us a line on the reasons for leaving. This sheet will be even more valuable to us when we make up a yearly or semi-yearly summary. At present, our departmental figures are so small that it is misleading to reduce them to percentages.

Early in the summer permission was obtained to open a locker room for the girls in order to provide a safe, clean place for their street clothes, as a substitute for hanging coats, hats and skirts on nails driven in the walls. A large, bright corner of a stock room was partitioned off, furnished with racks, benches and mirrors, and its use at first encouraged, then required, at least by the departments nearest the stock-room. The need for the room was emphasized by the fact that the girls had no place to change into the bloomer costume that we were urging them to adopt. When this main objection, of "no place to change" was removed, the younger girls bought the bloomers readily. The bloomers are now worn by a large percentage of the girls, and caps protect their hair from the lint that cannot be entirely prevented in certain operations of the cotton textile industry.

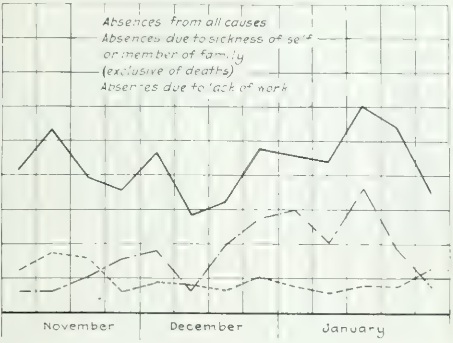


CHART 3. TOTAL ABSENCES FROM WORK IN RELATION TO TOTAL NUMBER ON PAY ROLL—AND TWO CHIEF CAUSES OF ABSENCES—BY WEEKS NOV. 1, 1917-JAN. 31, 1918

Table 1

HOSPITAL CASES BY TYPE AND BY SEX

October, November, December, 1917

	Total Cases	Total Individual	Medical		Accident		Compensation Cases
			Cases	Individual	Cases	Individual	
Total	409	281	193	129	216	152	9
Male	192	151	69	56	133	95	7
Female	208	123	118	69	90	54	2
Family	9	7	6	4	3	3	–

Total redressings	456
Average per day	2.6 Medical
	2.9 Accident
	6.2 Redressings
	11.7 Total average per day.

Table 2

MEDICAL CASES BY CAUSES AND SEX

October, November, December, 1917

	Total	Male	Female
Total	187	69	118
Digestive disorders	42	12	30
Colds, sore throats, etc.	36	18	18
Boils and eruptions	24	16	8
Eye trouble	18	6	12
Cramps	12		12
Rheumatism or neuralgia	8	4	4
Teeth	7	2	5
Venereal	5		5
Headaches	4		4
Infection	4		4
General breakdown	3	3	
Kidneys	3	2	1
All other causes	21	6	15

Table 3

ACCIDENTS BY DEPARTMENT AND SEX

October, November, December, 1917

Department	Total	Male	Female
Total	223	133	90
Quilling, spool, winding	64	11	53
Weaving	50	39	11
Twisting	45	33	12
Beaming	16	9	7
Stockhouse	10	10	
Machine shop	10	10	
Outdoors	9	9	
Cloth room	9	5	4
All others	10	7	3

The Night School

The formation of a night school for employees speaking little, and reading little or no English, seemed of prime importance after a census of employees, showing a popular demand for such school. Early in the fall, plans were set in motion to provide these rudiments of education. In the course of interviewing members of the state as well as the town boards of education, as to the best ways and methods of conducting such a school, and in trying to find the right teacher, a keen interest was aroused on the part of the public officials. The Board of Education granted a sum of money for the support of the school as a part of the public school system, offered rooms in a school building and advertised it freely. The school opened with 20 students, largely operatives of our mill, and now has an average attendance of 35, though it is in no sense compulsory. The village is so small we feel highly gratified at the outcome.

In addition to the opening of this department during the past year, the company has recently built two or three dozen very attractive and individualized houses for employees in the vicinity of the mill, and now has in course of construction a 14-family tenement court modeled after the group plan of the English garden cities for working men. As it was no one else's job, the weekly inspection of these houses has been turned over to our department, and we have started a campaign at the same time for improving local standards of cleanliness and beauty. By making the inspection less formal and authoritative this proved a remarkable opportunity to gain friends. We feel that this is a chance to extend the work of the department which does not often come unsought.

Any expansion along recreational lines has been curtailed on account of the war, but every encouragement is being given us by the manager and directors in building up on the foundations of service work as they have now been laid.

One year from the time this work was commenced in the mill, an Employment Department was inaugurated. This office is the turn-stile into the mill—no applicant can be hired by an overseer until he has had a physical examination and been passed by the Employment Department. The labor conditions are such today that everyone in the mill from the "Super" down, aids in finding new employees. There is a pride in keeping up the excellent standard of the mill with the result that this is one of the very few textile mills doing Government work which has not had a strike within a year.

One of the most encouraging results of the work of the department is the hearty coöperation that we now enjoy with the management, from superintendent to overseers. As they have learned the uses of a Service Department, and that is what the name implies, their indifference has changed to confidence. We feel that these officers are our real friends, and incidentally, there is not one among them who has not brought some personal problem to us for advice or assistance. It is impossible to overestimate the value of the coöperation of the overseers in a plant, for without it no service work can succeed.

TABLE 4
ACCIDENTS BY CAUSE AND SEX
OCTOBER, NOVEMBER, DECEMBER, 1917

	Total	Male	Female
Total	223	133	90
Cut on knife or clips	31	18	13
Cut or scratched on metals	29	22	7
Splinters	22	10	12
Falling beams and other objects	16	15	1
Fingers cut on yarn	15	4	11
Hit on machine	12		12
Hit on spool or box	11	6	5
Caught or struck by machine or tool	9	8	1
Broken springs, etc.	9	1	8
Flying shuttles or other objects	9	6	3
Due to falls	8	7	1
Sprains or wrenchings	7	7	
Burns	6	2	4
Hurt by moving machinery	5	3	2
Jammed between two objects	5	3	2
All other causes	29	21	8

Chiefly nails, box corners, tin, etc.

This brief account, which shows very sketchily the main line along which the work has progressed, is but a beginning of what we hope to accomplish as time goes on, and may serve to illustrate how service work may be adapted to the needs of a small plant. Surely because the plant is small the department is no less necessary than in a large plant—we even raise the question, "Is it not *more* necessary?

Airplane Cost Finding

By C. H. Hart

Cost Department, Aeromarine Plane and Motor Company

COST finding in airplane manufacturing plants is at best a very difficult task. This is due to several conditions: changing design, high grade of workmanship demanded, lack of spruce, and the experimental work that each plant must do.

It is impossible in the light of a continual changing design to standardize any requisition, material list or operation. A very high grade of workmanship is demanded and likewise the materials must be of the very best. Often when rejections on a single part, as a large wing beam, are severe the rejected part may be used to make smaller parts. Taking into consideration the limited ability of the average foreman or straw boss to handle a transfer of material via the requisition route, the problem of the cost department in this one item alone is difficult. Very often production is held up for the lack of spruce, in the meantime the productive time of employees must be charged. The main hours of fuselages or bodies then show a wide variation. Then again the question of the proper handling of experimental charges so that no particular group of planes is unduly overburdened with indirect expense demands constant study.

Briefly speaking, the cost department of an airplane plant is divided into a genuine cost department and a planning or order department. The latter has the entire charge of all stores, the issuing of orders in accordance with the pre-arranged production schedule, the regulation of the flow of production, and should know well in advance the parts which are behind schedule.

The parts are made and turned into parts stores and the work from that point until the machines are finished is largely an assembly operation. A production order the total of which when divided by the number of pieces produced gives a cost per piece is used up to the point of the parts stores stockroom. In connection with the production order a 5 x 8-inch card has proven very valuable. On this card are registered the production order number, man hours, labor cost, material cost, burden cost, pieces made and cost per piece. Thus when two or more orders have been completed on the same part number and entered on the card a comparative cost is easily and quickly obtainable.

ORDERS AND SYMBOLS

From the parts stores the planes take on an individuality and are known by numbers. It does not matter whether they are bunched in one's, two's, ten's or fifty's. One order number is sufficient. A very unique idea is often used, the machine number or numbers is also the order numbers as 150-160. This accompanied by a —1 indicates the fuselage or body,—2 the engine installation,—3 the assembly of the panels,—4 the complete assembly. Thus the cost of the fuselage of a single machine or of a particular group of machines is readily obtainable and this total can be compared with the same corresponding item of another machine or group. Then too, if the time-keeper has done his work faithfully an increasing cost is automatically brought out prominently and its cause should be ascertained.

In connection with the material as was mentioned at the beginning the use of material rejected for one part for a smaller part presents a serious problem unless a high grade man is on the floor constantly to transfer requisitions simultaneously. The writer prefers on account of factory conditions to let the charge stand against the original part simply writing "rejected" as material charge against the smaller part. In connection with such units of the machine as are not undergoing changes the following practice has proven a great labor saver and simplifier. A standard tote box of the necessary dimensions to take parts enough to do one operation complete is filled at the parts stores. The requisition in this case is a standard printed assembly list. This is held by the cost division together with the remaining standard lists until all for that operation for the machines on that particular order are completed. These are entered on the parts stores cards in total and when priced are entered in the control account in total. So that if 100 wing tips are on the order (50R and 50L) there would be 50 standard requisitions each bearing the correct parts to produce one set. In pricing one and taking 50 times its items from the cards forty-nine by fifty of the labor under the individual way is saved.

Burden is preferably divided on the man hour cost and, although a piecework system of payment is in use, it is better accounting to carry a time record as a basis. Piecework is not a function of time, but a function of quantity while burden in a broad sense cannot be divided on any other basis but that of time or function of time. Burden increases in a ratio which is practically directly proportional to time. Administration, rent, depreciation, taxes, and power are all proportional to time.

It is impossible to lay out a cut and dried system for any business that will give results.

How the Engineer Stops Foundry Losses

Defective Castings—a Total Loss of Foundry Labor and Supplies—Can be Prevented by Proper Design

By Stephen B. Phelps

This article presents the results of an investigation into the causes of defective castings of a gas engine cylinder. The fact is plainly brought home that ofttimes poor castings are not the fault of the iron or the molding; for improper design may cause cracks and shrink-holes. In addition to showing how the modifications of shape and section make for sound or spongy and cracked castings, the influence of chills in eliminating impurities is illustrated.

Mr. Stephen B. Phelps *has worked both as a journeyman pattern maker and journeyman molder for such well known firms as the Southwark Foundry & Machine Co. and the Standard Steel Works. This experience was followed by a course in metallurgical engineering at the University of Cincinnati, and employment with the Modern Foundry Co. and the Laidlaw-Dunn-Gordon Co. He is now assistant superintendent of a gray iron foundry in the East.*

AT the present time the attention of the country is centered largely on rapid production in engineering lines, but the output in some branches is much below its possibilities for an equal expenditure of capital and labor. The writer wishes to call attention to the total loss of labor and complete loss of supplies, except scrap iron, which results from foundry losses.

The designer or engineer may think that he is not responsible for foundry losses, but the writer has found that in certain cases the design effects the losses as much as the analysis of the iron. The design affects the losses even if the best materials can be obtained but it is doubly important during war times when foundrymen must sometimes use coke and iron which are not of standard quality and employ men who are not expert mechanics. The design of castings has, therefore, become a subject worthy of considerable research if we are to produce all types of castings without a heavy loss.

The design of sections of castings will be emphasized as the sections affect the losses to a large extent regardless of the type of casting. An investigation was made on gas engine cylinders which had to withstand 120 pounds gage pressure in service. Attention is called to the fact that the cylinders were being cast during the winter of 1917-18 when at times it was not possible to get good coke or iron and yet the cylinders continued to pass the tests. The castings of course were hard or soft according to the composition of the iron. Various persons and foundries have made the cylinders with which this article deals but with only a partial success and then the contracts were surrendered. At times the losses on testing were 95 per cent. ond the cylinders were returned by the carload. The foundries lost thousands of dollars and the engine company was dissolved several times largely, if not entirely, because of the money lost on defective cylinders.

The writer investigated the trouble and then made changes in the foundry practice that at once produced profits for the foundry and engine company. Sixty per cent. of the first lot of cylinders tested were good and when all the changes were made practically all the cylinders passed the test, and those rejected were not due to the original trouble but to accidents, bad molding, etc., and should have been rejected at the foundry.

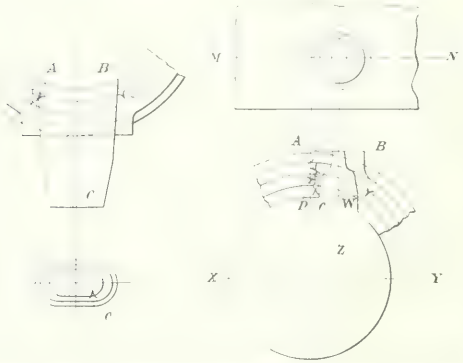
The production of cylinders was not halted to make the changes required as the engine company had many engines ready for shipment except for the cylinders. Therefore, the change in foundry practice had to be gradual and castings were made by both methods for weeks, the iron for each casting of the same date coming from the same ladle and the other foundry conditions being the same. The percentage of leaks, etc., in the castings made according to the usual foundry methods were much higher even at the start and when some castings were made entirely by the new methods practically all passed the tests. This was conclusive proof that the production of good cylinders was not due, except to a small extent, to the change in the mixture and analysis, but was due to adopting methods which caused the properties of cast iron to operate so as to produce sound sections as desired.

INVESTIGATION OF THE PROBLEM AND THE REMEDIES APPLIED

Impurities in Sections of the Castings.—The writer broke up a number of the cylinders and discovered that one of the chief causes of rejection was foreign matter or dirt in the walls of iron around the magneto hole shown in *A* Figure 1. Sometimes the impurity had been knocked out and left a hole or spongy place. The walls surrounding the magneto and spark plug holes were thinner than the walls of the cylinder or water jacket. It appeared, therefore, that the dirt was trapped as it was floating to the top of the mold for the iron froze first at these points due to the thin section.

The remedy for this condition was at once seen to lie in the field of metallography which covers the theory of solutions. According to this science, "The pure crystals of a solution freeze first and the mother liquor freezes last." Therefore, the foreign matter must be rejected by the pure crystals and will be frozen last with the mother liquor. When dirty water freezes most of the dirt will be precipitated because of its specific gravity though some will float for the same reason. That which remains in suspension or solution after freezing is well under way will, however, be found in the centre of the ice. This is caused by the freezing of the pure water first, from the outside to the centre. The pure crystals reject the foreign matter and it is found in the portion last to freeze.

When metals freeze the same conditions obtain and as a rule the dirt rises to the top or else is found in the sections last to freeze. It must, of course, stop migrating as soon as the section in which it is located freezes, even though other sections are still molten. In order to cause the above phenomena to produce good castings instead of bad ones two things were done: First, the sections of metal around the spark plug and magneto hole were made equal to the section of the cylinder and the water jacket. This would tend to allow the impurities to float to the top of the mold or else allow them to migrate to the center of the walls and thus not cut them clear through. Second a chill *C* Figure 1, was used to core out the magneto hole, instead of a sand core, in order to freez the inside of the walls first and tend to drive the dirt to the opposite side and thus insure a thicker section of pure metal. Similar leaks were discovered in the walls of the spark plug hole, as at D, Figure 2, and they were treated in the same manner. After this was done several cylinders which had been rejected for bad molding were broken and the sections about the magneto and spark plug holes showed a pure fine grained metal near the inner wall.



FIGS. 1 AND 2. DIAGRAMS OF SECTIONS OF GAS ENGINE CYLINDERS

NOTE.—*Method of Molding.*—The cylinders were cast on their sides but that is not necessary in order to use the chills which are referred to later on.

The circle *Z*, Figure 2, represents the center core with its offset *W*, which supports the tapered iron spark plug chill. The center line *X-Y* represents the parting of the mold and the section above it is cast in the cope while all under the line is made in the drag. The spark plug chill is thus in the cope while the magneto hole chill *C*, Figure 1, is set below it in the drag.

Sometimes shrinkage holes had been the causes of leaks in these sections. This was due to the unequal thickness of the walls at this point and because the walls around these holes were not always uniform due to irregularities in molding and core-making.

Interior Shrinkage.—The second chief cause of rejection was the leaks which occurred in the bore near the closed end of the cylinder. In order to cool the cylinder head holes were cored as in Figure 3, in the end of the cylinder for the water to pass into the head. On either side of the holes the barrels of the cylinder was connected to the jacket by sections of metal as at *Y*, which caused a thicker section of metal here than the rest of the barrel, say than at *Z*. The cause of the leaks was shrink holes or depressions, as at *W*, which extend into the bore or very close to it after the cylinders were bored. This type of shrinkage is frequently seen when a thin section of metal joins a thick one at right angles. The thin section cools first and as it shrinks it draws the molten metal from the heavier section. The heavier section is also cooling so the two sections draw away from each other at the corner as at *A*, Figure 4.

Examination of many types of castings show the above to be true and also the phenomena of a solid section where the change in thickness is gradual, as in Figure 5. Points *A* and *B* show where shrinkage is likely to occur in sections of the design of Figure 4, while if a section or casting is designed, like Figure 5, it will be solid or may have a coarse grain or slightly spongy portion at *A*. The reason for the casting designed like Figure 5 being solid is that the graphite has more time to separate from the iron and in so doing it occupies more space. The crystals have grown larger toward the heaviest section. A wedge section was made, shown by *C* and *D*, Figure 6, and this gave the desired results and eliminated shrinkage or else caused it to take place nearer the water jacket *E*, where it could not cause leaks.

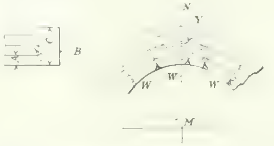
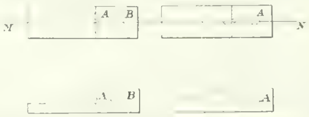


FIG. 3. SECTION OF CYLINDER HEAD SHOWING HOLES CORED FOR COOLING

Shrinkage Cracks.—The third major cause of rejections was cracked barrels. It was the custom to knock out the castings as soon as possible after they had set. In doing so the center or barrel core was broken at the ends thus exposing the end of the barrel to air currents which cooled it rapidly while the middle of the barrel cooled slowly. The end of the barrel was thinner also and this also caused it to cool quicker. The result was that unequal cooling stresses were set up which resulted in cooling cracks. The end of the barrel was made heavier and the castings were left in the molds as long as practical and the trouble was eliminated.



FIGS. 4 AND 5. DIAGRAM SHOWING EFFECTS OF SHRINKAGE

CUPOLA OPERATIONS

A mixing ladle was used at the cupola and 2000-pound charges were melted throughout the heat. Calculations made from the dimensions of the ladle and from the weight of castings poured showed that it only held 1700 pounds. So in order to allow a whole charge to run in the ladle and thus insure better mixing the charges were reduced to 1700 pounds.

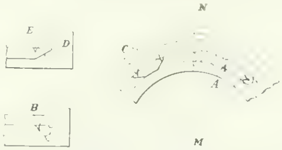


FIG. 6. CHANGE IN SECTION TO AVOID SHRINKAGE TROUBLES

A CONTRACTING CHILL

Manufacturing considerations determined that the spark plug hole should be cored out partly by the sand barrel core and partly by a chill. This fact presented another difficulty because a high stress is set up in the walls around the spark plug hole when the castings starts to cool. If a sand core is used it would be crushed if it was not too hard. In this instance the core would crush easily because of its composition but a chill would not crush and it would also cause the metal to contract faster around it thus setting up a difference in the stresses. The common type of chill was used at first as it was inexpensive to make but a close inspection was made for shrinkage cracks which might develop as pointed out above. It was fortunate that such a possibility had been considered otherwise many castings would have been ruined by cooling cracks. The larger cylinders developed cracks of this type more often than the smaller ones. This was due to the fact that the circumference of the larger holes was greater and therefore the shrinkage would have been greater if a sand core had been used in each instance. However, neither wall nor circumference could shrink, except that portion cored out by the barrel core, therefore the stress was greater in the wall with greatest circumference because of the attempt to shrink the normal amount in each case. In order to prevent losses from this source the writer designed a contracting chill which allowed the walls of iron to shrink and thus relieve and equalize the stresses.

Mixture and Analysis

Consideration was given to the properties of the elements which compose cast iron and in order to avoid shrinkage as much as possible the graphitic carbon was increased by increasing the silicon content and by melting at a higher temperature. Phosphorous was raised for the same reason and sulphur was lowered when possible. Many times, however, it was not possible to control the mixture. The writer did not make a special mixture then, but used the general iron. At one time seven-tenths of the mixture was scrap and the sulphur was over twice as high as generally recommended and yet the cylinders continued to pass the tests. Such conditions would have resulted in nothing but defective cylinders with the usual foundry methods.

Conclusion

The results of this investigation will interest the designer in that it illustrates the fact that an engine or other type of machine may be designed so as to be efficient in working properties yet the manufacturer may be bankrupted if the effect of the sections of castings on the properties of metals is not known.

The foundryman will notice that it is not always the fault of the iron when castings are lost because of shrink holes but rather the abrupt right angled connections of heavy and light sections.

Metallurgists will find a new application of the theory of solutions, and the foundryman another use for chills in adapting them to eliminate impurities from a given portion of a casting and thus produce sound sections where desired.

Heat Leakage Wastes Coal

By Austen Bolam

To merely refrain from using coal does not necessarily mean economy, especially if by so doing production of some vital necessity is curtailed. Rather should we use more coal, provided we make sure that every pound is doing its full duty. But to burn 10 pounds of coal and only to utilize the energy from five pounds—that is waste of the most reprehensible description.

Unfortunately, every coal user must plead guilty to this offense in a greater or lesser degree because even the most efficient of our steam generators, the modern water tube boiler, at its best utilizes about 70 per cent. of the energy available from every pound of coal it consumes. Under current conditions it is doubtful whether any further improvement is possible since, despite all the most modern appliances, at least 20 per cent. of the heat goes to waste in the chimney stack alone.

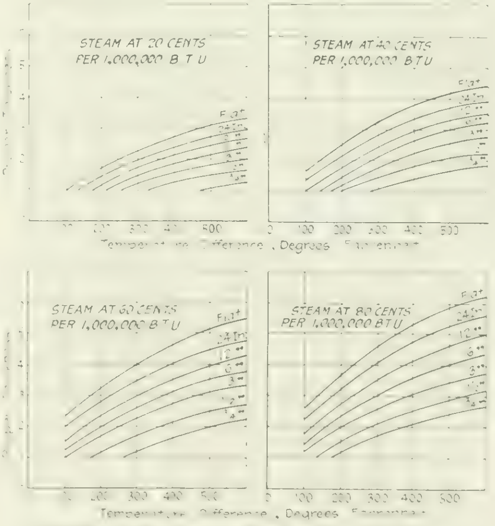
The greater part of the 10 per cent. of losses remaining to be accounted for are caused by radiation from pipes, boilers and fittings, and it is this radiation which is at once the most insidious of our many heat thieves and the most easily controlled. The first point to be noted is the fact that these radiation losses are almost equal to the total *available* steam efficiency. They are therefore important enough to deserve far more serious consideration than is usually accorded them.

WHEN A POUND OF COAL IS BURNED

This diagram shows what becomes of its original 14,000 B. T. U. Each division represents 1000 B. T. U. shaded portion shows losses. Figures from "How to Build up Furnace Efficiency."

Before discussing these losses and their remedies, let us, however, perform a few simple calculations which may help us to understand better some of the figures to be later presented. The standard of heat measurement, the B.t.u. (British thermal unit), equals the heat necessary to raise one pound of water one degree Fahrenheit. There are from 10,000 to 15,000 B.t.u. in a pound of good coal. One pound of coal produces seven to nine pounds of steam, according to the efficiency of the boiler, and each pound of steam represents about 2,000 B.t.u. expended in its production.

Now *one square foot* of bare pipe (or its equivalent in other uncovered metal surfaces such as valves, flanges, fittings, etc.) will waste, at 150 pounds steam pressure, 937 B.t.u. per hour or about half a pound of coal—11 pounds a day, or about a ton and a half a year, after allowing an ample margin for non-working days.



THICKNESS OF PIPE COVERING FOR MAXIMUM NET SAVING.

Further investigation reveals ignorance as to the functions and values of the various heat insulating materials used. Provided the surfaces are covered, few tests are made as to the actual efficiency of the covering itself. In fact, there is apparently no department of steam engineering where the "rule of thumb" method is so extensively cultivated as in this.

STRUCTURE OF HEAT INSULATION

Let us consider for a moment the structural requirements of an efficient heat insulating material and begin with the structure of a metal which is a good conductor as compared with the wool or feathers that protects the animal or bird from the cold. We find the metal is close, heavy and homogeneous in texture. It has no empty spaces, nothing to oppose the rapid conduction of the heat from particle to particle. Hence it is ideal for the heating surfaces of boilers, radiators, etc., wherever heat is required to pass quickly and with the minimum of loss.

On the contrary, wool and feathers are loose and carry a large quantity of *air* enmeshed in their fibres. When it is cold, and the bird fluffs up his feathers, he is really increasing the thickness of his air protection.

Now air that *circulates* is a heat thief. Convection is merely another name for air circulation and convection shares with radiation and conduction, the responsibility for all heat losses. We can see an example of this in the rapid cooling of any heated body when exposed to a brisk current of air. Dead (or stagnant) air on the contrary is a heat saver, but true dead air can only occur when it is subdivided into miscroscopic units so confined as to be absolutely incapable of circulation. Hence the ideal heat insulation is a mass of minute air-cells, with the minimum of solid material necessary to hold them together.

Owing to the high temperature of high pressure steam pipes, organic materials are necessarily barred, although otherwise there are many of these that possess the requisite air-holding capacity. We find our best and most practical heat insulations among the non-organic materials.

SELECTION OF HEAT INSULATION

Let us see how to put our knowledge into actual practice.

First of all, in the selection of the correct material to be used we find that a non-organic material of high dead air capacity is essential.

Second, the thickness of the covering must be in proportion to the temperature of the object to be covered. An insulation that is amply thick for moderately low pressures is insufficient for high pressures or superheat.

Third, it is not enough merely to cover the larger surfaces. Every point from which heat radiates is a coal waster. A survey of most steam plants will unearth many hitherto undercovered sources of heat leakage.

Fourth, in order that we may obtain a fair return from our investment, the covering must be *durable*. A good insulation should last as long as the metal it protects. Instances of over 25 years' continuous service are not uncommon.

One trouble is that most insulations *look* alike, especially when they are on the pipes or boilers. Once they are installed it is the exception rather than the rule to inspect or test again. Therefore an inferior covering may have lost by far the greater part of its insulation value without this being in the slightest degree apparent to outside observation. At a large Pennsylvania steel plant a few years ago, an old pipe covering, several hundred feet long, was removed, and found to have totally disintegrated. In fact, it was nothing but a bag of dust. How long it had been in that condition nobody knew, but it was evident that for many years it had been merely so much "camouflage" on the steam pipes.

That this is by no means an isolated instance is well known to engineers whose work brings them into contact with a large number of steam plants. In fact, the marvel of heat insulation is the general indifference to and ignorance of the whole subject.

Business Principles—A Discussion

By Harold Bates

Assistant Construction Engineer, The Connecticut Company

IN the July issue of INDUSTRIAL MANAGEMENT I note in the principles outlined by Mr. C. E. Knoeppel before the Federal Trade Commission that under principle 6 he states "costs of operation should not have included in them any charge covering interest on investment, etc."

Will not this defeat the very object we are all trying to attain, greater industrial efficiency?

It is essential that selling prices should be based on the most efficient operating costs, and to determine such costs, all of the elements by which efficiency of operation is gaged should be included, among which is interest on the investment.

There may be quite a difference in the labor costs in different manufacturing plants involved in the operations of producing the same article, but which is the most efficient? Excessive investment in equipment may make the selling price greater for the article produced with the lower labor cost in order to realize an adequate return on the investment, therefore, the business as a whole of manufacturing this article would be less efficient. But where less efficient? To determine this is it not necessary that we have included in the cost of each operation involved in the producing of any article interest on the investment, and thereby create a gage for measuring, comparing and analyzing efficiency in the various operations, instead of only for the entire business?

The three necessities in practically all production operations are labor, material and equipment, therefore why should not the cost of these elements be included in operating costs? There is a charge for labor and for material and also a charge for the money to provide the equipment. This latter charge may be in the nature of interest on bonds or dividends on stock, but it is the actual cost for the use of the investment in equipment.

"SERVICE AT COST"

I have in mind a recent bill passed by the Massachusetts Legislature affecting certain railway industries called the "Service at Cost Bill." The desired results to be realized are: a just price to the public for the product (in this case service), a guaranteed fair return to the investors, and the maintenance of good service. The fare or price to be charged is to be based on the cost of producing good service and such cost is to include return on the investment.

If labor or material costs increase, or a greater return on the investment is necessary to attract capital and the cost of operation thereby increased, the fare is accordingly raised.

If these elements enter into the cost of the finished product why should they not also be included in the cost of any one of the operations included in production?

Efficiency is the ratio of the work, energy or wealth that is obtained from any operation to that put into it; but if all of the elements put in are not included in the comparison, how can the ratio be relied upon?

The sum or end efficiency of a business is only so good as the efficiency of its various operations, therefore, do not cut out of operating-cost statistics any of the facts necessary to show the management where total efficiency may be increased.

What an Industrial Census Can Do

Results of an Experiment of the Miller Lock Co.

By Dale Wolf

Listing 10,000 *persons of working age living within a mile of the factory, securing all the workers, both men and women, needed at present including persons for a few very responsible positions, and the beginning of half time work with women—these are some of the immediate, tangible results of this industrial census and the follow-up efforts to recruit employees.*

Mr. Dale Wolf *was trained in daily newspaper journalism and had some four years' business experience in the Middle West. For nearly three years he was Industrial Betterment Extension Secretary of the Central Y. M. C. A. of the City of Philadelphia, specializing on employment and labor maintenance problems. He is now Director of Employment of the Miller Lock Co.*

"THE logic of your letter has appealed to me," said Mr. Libhart (then superintendent of the parts department of a large automobile industry) as he introduced himself to me one morning a few months ago.

"Since getting your letter I have figured out what it costs me to run my car clear into the city and back each day and I find that the expense is about $2 a day, or over $600 a year for transportation alone. There is the time it takes, as well, which causes me to realize that I could afford to work nearer home at a good deal less money, if I could find something in my line."

Mr. Libhart and I fell into a "conversational interview" in which he explained that he had been following the stores side of manufacturing most of his life, and felt most competent to work in that line. Before the "conversational interview" was ended, we were so well acquainted that an arrangement had been made for golf a few weeks in the future.

We had no opening for my new acquaintance. However, I explained to him the details of a possible job we might some day want filled, and told him that I would bear him in mind if something turned up that looked favorable. In the meantime, would he be kind enough to fill out one of our application blanks so that we could have it on file for consideration when a possible opening developed.

Two days later the purchasing agent resigned to take up a larger work in another field and our superintendent of stores was promoted to the purchasing agent's desk. When it came to select the successor to the superintendent of stores there was no one in the organization that we felt could fill the bill; so it was up to the employment department to find some one. But our census letter had already found the man for us. Within half a day after the conference regarding a new superintendent of general stores, Mr. Libhart had been employed for the job.

"It's a fine record of the employment department being on the job," said the works manager in commenting upon the change in the general stores rooms —and we felt fully paid by the compliment.

This incident is only one of many that we have had in relationship to our industrial census which was started a little over a year ago. The plan as inaugurated by the Miller Lock Company was not radically different from similar plans. The results will never be known, as we can "feel" some of the effects that cannot be placed down in cold figures or statistics.

Surroundings of the Plant

The plant of the Miller Lock Company is located about nine miles from the business section of the city of Philadelphia in an industrial community known as Frankford. Transportation facilities from the community to the center of the city are very poor at present, and the installation of a high-speed elevated railway service has been stopped because of the war. Competition for help is keen. The Frankford Arsenal of the United States Government is within a twelve-minute walk of our factory. This plant has about trebled its force since the war began. Around us are many other modern plants engaged in war work, all just as keen after employees as ourselves. Our problem was to man the machines and keep them manned, and we had decided that one of the best possible agencies to use would be an industrial census.

We started the industrial census of our community by first laying out the amount of territory that we desired to cover. It was our aim to canvas every home within a fifteen-minute walk of the factory. We did not know what the response would be when we started out to meet these people and ask them a lot of questions, but we knew how to find out—go to it and do it. This we did.

Beginning Our Canvass

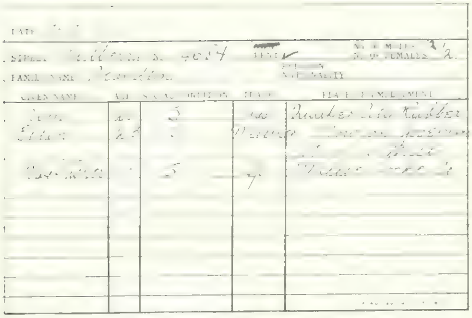
The man first put on the canvass was an elderly Gentlemen (spelled with a capital G) who had for years been a bookkeeper. His success in securing the desired information was satisfactory, and we kept him on the job until we hit upon a better plan.

We tried to improve the canvass by getting a minister to help with the work. We found an Episcopal clergyman in the community who was not adverse to making some extra money, and we put him on the job paying him by the hour. The clergyman never appeared in anything but ordinary business dress, so his diplomatic approach to the people proved to be a great help in getting the desired information.

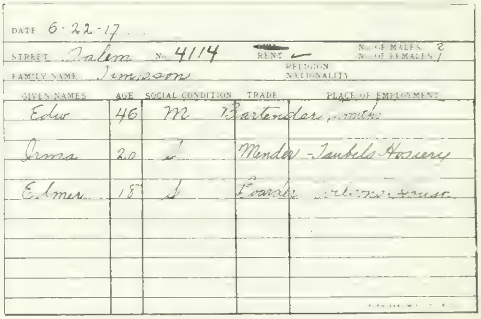
We told the people very frankly what we were about and WHY.

The canvasser would explain that he was taking a census for the Miller Lock Company, getting the names of all residents living within a mile of the factory. That some day these names would possibly be used in getting the residents of the home a good job at "the Lockie." Of course there were some people who said that they did not want to have "the Lockie" offer them a good job, but these were few. In such cases the canvasser had a splendid opportunity to get in some real good work, correcting any misapprehensions that might be held regarding our factory and the working conditions therein.

We used a blank card, properly prepared, for the information record. Whoever came to the door generally gave the information desired, and sometimes a child would answer the questions, frequently saying



SAMPLE CARD OF INDUSTRIAL CENSUS



DATE 6-22-17

STREET Salem No. 4114 RENT ✓ No. OF MALES 2 No. OF FEMALES 1

FAMILY NAME Jimsson RELIGION NATIONALITY

GIVEN NAMES	AGE	SOCIAL CONDITION	TRADE	PLACE OF EMPLOYMENT
Edw	46	M	Bartender	[illegible]
Irma	20	S	Mender	Taubels Hosiery
Elmer	18	S	Boarder	[illegible]

CONSIDERABLE VARIETY OF OCCUPATION SHOWN

things that would not be said by an adult, but still useful in the canvass.

An Incident Following the Census

I recall a recent explanation regarding the census that was being given to a young woman who visited our plant. On asking her address I went to the census file and pulled out the card for her address, on which there was a small history of her family.

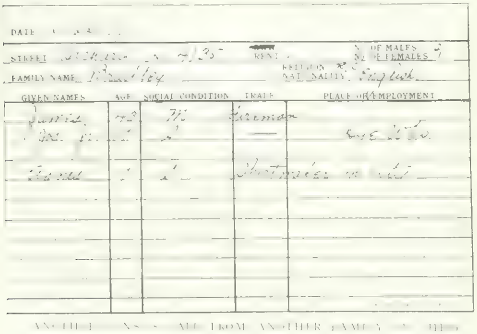
"Yes," she said, "I remember my little brother saying that he had told a man about our family, including my oldest sister (indicating the sister's name on the card). However, that sister does not live at our address, as she is a nurse living at the nurse's home in the center of the city."

"Well," I replied, "wouldn't it be nice if your sister could live at home." To this she agreed, and I went on, "By having her name on this card it may some day be possible for her to follow her profession and live at home. You see, the next time we have a vacancy for a nurse in our own factory hospital, instead of running all over the city to find a nurse we might offer the position to your sister. She could then work right here within one square of her home, follow her profession and live at home all of the time. wouldn't that be nice?"

"It certainly would, and I hope that it will come to pass some day," was her enthusiastic reply.

Statistical Result of the Census

We gathered about 4,000 cards by our methods of canvassing. These cards represented not less than 16,000 persons of all ages, and not less than 10,000 persons of the present day working age. Many of these people were already our own employees, and many of them persons who had formerly worked for us.



ANOTHER [illegible] FROM ANOTHER FAMILY [illegible]

We filed all of the cards by streets, running them numerically down the street. We felt that we should first begin our campaign on the community as a whole, rather than upon certain occupations that were represented in the neighborhood. The cross file system of occupations, sexes, nationality, etc., could come later.

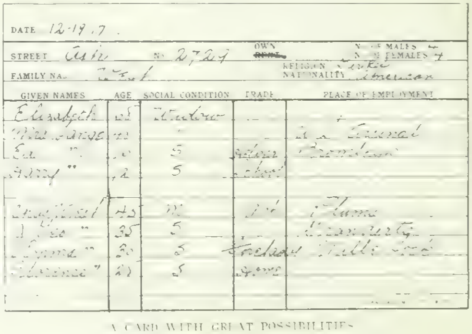
Our campaign was designed to follow out the policy that we have always had: that a man could work better, more efficiently and be much happier and more contented if he worked near home. Three letters were written, which were designed to hammer home the idea of "WORK NEAR HOME."

Our First Community Letter

The first letter appealed to the pocketbook. The case cited in the letter was that of a young woman who is now one of the chief clerks in our production department. The figures we had used in her case had appealed to her sufficiently to have her report to work for us at the same salary she was getting in the city. We felt that this same reasoning would appeal to others. It was simply citing how much it cost an individual in time spent traveling (at their hourly wage rate) from their home to their work and back again.

You can imagine our suspense when we sent out the first batch of 100 letters. We had spent a good deal of money on this proposition and these letters were going to tell the story of what the campaign was going to amount to. My assistant remarked the afternoon after the letters had been mailed, that during the day we had not received any applications as a result of the census letter. I was not discouraged and simply ordered the daily quota increased to 200.

But the following day our first results came. A young woman who had formerly been one of our best



A CARD WITH GREAT POSSIBILITIES

employees in the punch press department came in bringing the letter with her. To her the letter was a personal invitation to come back to her old job. But what made my heart glad was that fact that coming back herself was not enough, so she brought along a girl friend who was an experienced press operator. It is hardly necessary to tell you what happened to the future industrial career of these two young women.

From then on we kept sending out about a hundred letters every day until we had gone through the entire list. The results of this letter can never be tabulated. A sample of its "far-reaching-ness" is to be found in the case of a city salesman for a wholesale grocery house.

This city salesman worked our community and lived just a few squares beyond the zone of our census. In talking to one of his grocer customers the salesman remarked about his account with the restaurant of the Miller Lock Company. This caused the grocer to show the salesman the census letter that he had received from our factory. The salesman took the letter for it meant a new angle of business for him. His own daughter had been working in the city, 10 miles from home, and he wanted to get work near home. Here was a case of a man coming to our plant every week, and dealing only with the purchasing department. He had for a long time felt a yearning to deal with the employment department in regard to his daughter, but it took something like the census letter to call to his attention that this yearning could be fulfilled. We needed a record clerk in the employment office, and here was a girl doing the same kind of work 10 miles away from home, when she could have been working for the same money much nearer home without any car fare to pay. An interview followed arranging for the young woman to report for work.

Return of Former Employees

The majority of the people who applied for work as a result of our first letters were former employees. These persons knew about us, our factory conditions and our scale of wages. So it was gratifying to find that among the employees who went on the payroll during the first months of the campaign about one in every five was an old operative returning for reëmployment.

The first letter had brought in quite a few visitors. It was notable that many of these were old people. These old people had worked in factories in their younger days, and to see a plant where as much interest was taken in the human element as is done in ours was a revelation to them. They went out and talked about it, so that we received an increase of applicants from that class of men who are just able to work but do not because they feel that they have "had their day." These men we were able to put at lighter work in the plant, the assembling departments recruiting many of them.

Our Second Letter

For our second letter we decided to make a patriotic appeal, as we were engaged in doing about 50 per cent. government work. I did not like this letter as well as the first one, and thought it would not do as much good. And it did not at the start, and until we changed our system of mailing.

The results of the first letter showed us that most of the applicants who came for work as a result of the census letter were men. What we needed was women, and I asked several of our clerks to think up some idea as to how we could get women in on the job. Several ideas were suggested, such as offering special bonuses among present employees for bringing women putting on a special woman agent to try and recruit female labor. But I wanted something that would apply to this campaign.

It was finally suggested that as the letters were always addressed to men, and that these men were the chief recipient of letters that went into the household, we should address the letter to the women. The women of the home rarely receive a letter.

This was after we had sent out over 500 of the letters in the second batch. We then started addressing them to the oldest female indicated on the census card—and the trick worked with a bang.

In less than a week we had all the women we wanted and I was amazed one morning to find that the only requisition in the employment department was for a millwright.

If there had been women millwrights in the neighborhood we might have filled this requisition.

We not only got the women for working full time, but we got our first results from our attempt to follow out the idea outlined by Mr. Hugh Fullerton at the Rochester employment convention. In two days we had four women ready to put into practice Mr. Fullerton's idea of half time work for women, two women taking care of one job.

We put on all of the women we could get on. We immediately planned to discharge several piece workers who were occupying machines at big weekly losses of production, and proceeded to carry out this plan by making an example of a trouble-maker and lazy-bones girl in our rivetting department.

We have been credited with putting women on many jobs that have been held by men. This was our chance, and we started them in on work that was being done by boys and men. It took well, and I think that everyone got along all right, even to the first woman trucker. The boys started to get rid of the first of the female truckers by making fun of her. She stood it, although coming to the employment department three times to see about quitting. Just as soon as we put on a second woman trucker with her, she was ready to stand the fire, and her entrance into the industrial trucking world had been won. There was a cessation of the ridicule just as soon as the second woman went on the job.

The second letter also brought in some women who had their sense of patriotism appealed to in a strong fashion. I recall two elderly ladies who "wanted to do their bit," but didn't feel that they were young enough. They are now working at very light work in our japanning department.

For the time being we have stopped sending out any more of the second series of letters. We have stopped doing any form of advertising, or making any further direct appeal for help. The balance of the second series will be sent out as needed, while the third round of letters is yet to be used, before we even get half done with the harvest.

Harvest of the Census

We have just started reaping the harvest of this census. By vocations we little know what we have at hand. We have gone far enough to know that within a 15-minute walk of our plant live 33 firemen and 52 engineers. To a works manager who is having labor trouble in his power plant, would not this information, with the names and address of each man, be a great help in solving the trouble. It has been to us already, and we will use this information more than once. Men that we do not appeal to today may not be so situated tomorrow. The morning on which this article is being written, I was talking to one of the firemen in our census district. Two weeks ago he was out of a job, but today when we offered him a place in our boiler room he had a position. Will we use our census and go after him again? Sure we will, for he may become dissatisfied with his work in the meantime, and we may catch him on the psychological day.

Working Near Home

We have a place on our application blank that asks the applicant "Why did you apply here for work?" If any employment director will analyze the answers he gets to this (or some similar question) he will soon find out that there is something back of the idea of working near home, that is not alone in the brain of the employer. In the last two months 94 applicants at the Miller Lock Company gave as their reasons for applying for work at our plant such answers as: "wanted to work near home," "near home," "other job too far away," "didn't like to ride crowded street cars," "live near her," "it's close," and similar replies, all pertaining to the one main idea of working near home.

Looking ahead at the usefulness of the census I can see many things that we can do with it. In these uncertain war times, when not only the man-power, but the person-power of every individual must be utilized in industry if we expect to win this war and win it quickly, it behooves every manufacturer to locate and put to use the "person-power" whether it be old man, young man not in the army, but physically unfit, elderly woman, married woman, single woman, growing boy and girl, regardless of color, race, nationality or creed.

When we get done, we should know the answers to such questions as these: How many single women are in the community who are physically fit to work but are not working? How many married women of working age are near by, who have no binding home ties and who could and should be engaged in helping out in industry? How many women with home ties are there in your vicinity who could work one-half of every day? How many elderly men who are not working are there that could be doing some of the lighter work in your shop? How many men are there who have felt themselves physically unfit for labor, but who could be doing such work as light assembling? These questions show only a few of the possibilities.

Attitude of Other Employers

One question that has been frequently asked is: "What do the owners of the other factories in your neighborhood think of your census?"

With the rampant talk now current about stealing employees from one another, every manufacturer who thinks of undertaking an industrial census of his community will have to answer this question for himself. We did not ask the neighboring manufacturers if we could do this work. We went ahead and did it.

The result has been that we are still on the same friendly terms with our neighbors in industry that we have always enjoyed. One firm wrote us asking us not to send out these letters to their employees. We replied that with the rapid change in employees we could not tell that a man working for them last summer would be working for them this summer. However, if this particular firm would send us a list of its employees, and keep us posted as to the changes in personnel of its plant every two weeks, we would not send any of our campaign letters to anyone on their list. We explained also that this was a campaign of education to cultivate the idea of working near home. That if the educational side of the campaign was a success, they would reap a great benefit, just as we would. (And they will, too.) The reply to this was a list of the employees of our neighboring manufacturer, and we in turn put a signal on all of the cards that were in this list. This list is renewed every two weeks, and so far we have not found a case of our mailing a letter to this firm's employees.

Another firm wrote us a similar letter, and we made an offer exactly like the one made the first firm. So far this second manufacturer has not thought it wise to coöperate in the movement.

Letter No. 1

Dear Friend

Some time ago you were bothered by a man calling at your home asking a lot of questions about the members of your family and where they worked.

Perhaps you did not appreciate why this man asked you so many questions. Well, I will tell you just why,—we think and we think you do also—that it is a great advantage to work near home because you do not have to waste time going and coming to work.

Have you ever figured out the time you spend away from home, and how much it would be worth to you, figured on the basis of your pay per hour. A young lady living near here did this a few days ago and discovered that it was costing her (at her hourly wage rate) $4.30 every week in time lost, besides having her car fare to pay, which amounted to sixty cents a week.

How much of your life do you spend at home with the family when you are awake? Would it not be much nicer to get out of the factory from work at 4:55 in the afternoon and walk home from work in less than fifteen minutes?

Do you know anything about the Miller Lock Co.? Do you know how locks are made? Do you know just what your friends do who work at this factory? Bring this letter with you to the office and we will be pleased to show you thru the entire works. It would make a splendid excursion for your visitors from out of the city the next time they visit you.

We will be looking for you in to see us soon.

Cordially yours,
The Miller Lock Co.,
Dale Wolf,
Director of Service.

Does It Pay?

When you compare the cost entailed in securing employees by almost any means now used in modern practice, the cost of an industrial census is no greater than the cost of some of these methods. One day's advertising in the classified columns of a Philadelphia paper for a single advertisement for one man will cost over $5. The actual dollar and cents value of our industrial census will never be known to us, but already we believe that it has paid—and our dividends will continue to come in.

The industrial census must have back of it the good will of the community at large and the standardization of shop conditions. Our factory is second to none in Philadelphia for sanitation, social betterment and allied movements. We have a clean, well-lighted and well-ventilated plant. The usual betterment features such as a recreation center, restaurant, library, night classes, savings fund, social section, profit sharing, piece work bonuses, free life insurance, athletics, loan fund, rest period, roof garden, Boy Scouts, troup girls' patriotic league, choral organization, dental, medical and hospital care—all of these go to make the place attractive, and with them is an adequate wage scale. These things are *NECESSARY*; then you may count on *SUCCESS* for your industrial census.

Mastering Power Production—VIII

The Analysis of Records Leads to Real Mastery

By Walter N. Polakov

Power production mastery is a public interest, because the public can only be properly served if power is generated in the most efficient and economical manner known. Therefore, records should be kept and made public in order to reveal inefficiency.

This installment is given over to showing and emphasizing how important power plant records are, to explaining their purpose, pointing out what kinds of records should be kept and how they should be gathered, interpreted and used. Records of performance, maintenance, distribution, construction and of men are all necessary, and several complete logs are shown herewith.

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated abroad, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he became a consulting engineer to the Board of Estimate and Apportionment for the City of New York, then consulting engineer for the Penn Central Light & Power Company and later on was superintendent of electric power of the New York, New Haven & Hartford Railroad Company.*

THE production of power has always been in the hands of engineers, who are preeminently masters of materials and students of the laws of nature. The very foundation of engineering activity is the knowledge of facts and measurement, the relation between causes and effects. The interplay of the phenomena that engineers are called upon to master is reckoned in terms of mathematical equations and formulas, but—what sarcasm!

So long as the engineer remained a satrap and an obedient servant of his master, his knowledge, initiative and ideals counted for naught, he was paid to carry out the will of his employer. The law-maker and the money-lender were taught by sad experience that improper design or faulty calculation spells damage and money loss, and so long as the physical safety of investment is assured, the operating perfection mattered little, since the loss in the power department could be made up and covered up by other opportunities that business presents. Moreover, bromided accounting showing a net revenue, can cause no concern regarding the extent of power losses as it has no means to disclose and measure them. Hence—the boilers are equipped with safety valves and water gages; generators with voltmeters and circuit breakers; feeders with time relays, while the instruments enabling the operating force to adjust the conditions for the best economy and measure the efficiency attained in each stage of the transformation of energy from coal pile to the ultimate use, were generally ill favored by investors, since the operating losses were heretofore borne by the consumers of the product.

While the economic structure of our social and all other relations started to shake to the roots under the effects of the World War, the problem appeared before the investing class in a new aspect. It is no longer the question of losing a little in one direction and gaining more somewhere else. The wanton destruction of our fuel resources in mismanaged power houses appeared as a ghastly spectre of fuel famine[1]; the power shortage threatens to stop the dividend-grinding machinery and the day of reckoning has come.

Relief was sought, however, in the old, time honored remedies—more machinery, better equipment, special privileges. The government was to furnish the money to modernize "public utilities," the government was to issue priority orders, the public had to pay the excessive cost of new construction under abnormal conditions. The volume of electrical business increased, nay, multiplied, so that even a smaller rate of profit would yield under such conditions larger dividends; in spite of that, petitions were filed to raise rates, to permit skip-stops, etc.; inducements for use of higher watt lamps and other measures further enhanced the profit secured on the peoples' money, irrespective of wasteful mismanagement of plants.

The country at large and the public in particular, is also facing a new problem: The demand of the Public Service Commission that the public utilities must serve the public is to be supplemented now by another, *public utilities must be managed in accordance with the best known method and in the most efficient and economical manner.*

A correct method of record keeping is an indispensable means for exercising such a control and proper agencies should see *how* the service is rendered.

Purpose of Records

The purpose of records is obviously to show *what has been done.* In other words, the record is the means to establish the fact and as such it is the most powerful tool that management possesses. When the facts pertaining to the actual performance are known, the management is in a position to compare it with the ideal or practical task and thus judge the degree of perfection of its accomplishments. It is the function of records to show clearly, precisely and continuously:

1. Whether the loss occurs.
2. Where it occurs.
3. How it occurs.
4. What is the extent.

The more time that elapses between the occurrence and the analysis of the record, the greater is the volume of loss, *i. e.*, the less the value of the records. The value of the records becomes nil if no use of them is ever made. Moreover, the value of records may become negative if the records are inaccurate as the conclusions reached from the analysis will be wrong and the steps taken harmful.

The securing of accurate and instantly available records is, therefore, a basic condition for success in mastering production as well as distribution. Without a complete set of records, efficient generation of power is unthinkable, but the possibilities offered by record keeping may be realized only on condition that proper use is made of the story told.

The mechanism of securing records must be organically fitted to the process under observation. Mere results of a performance leaves room for speculations and

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[1] Washington, June [illegible] coal needs this year will be [illegible] tons in excess of production last year [illegible]

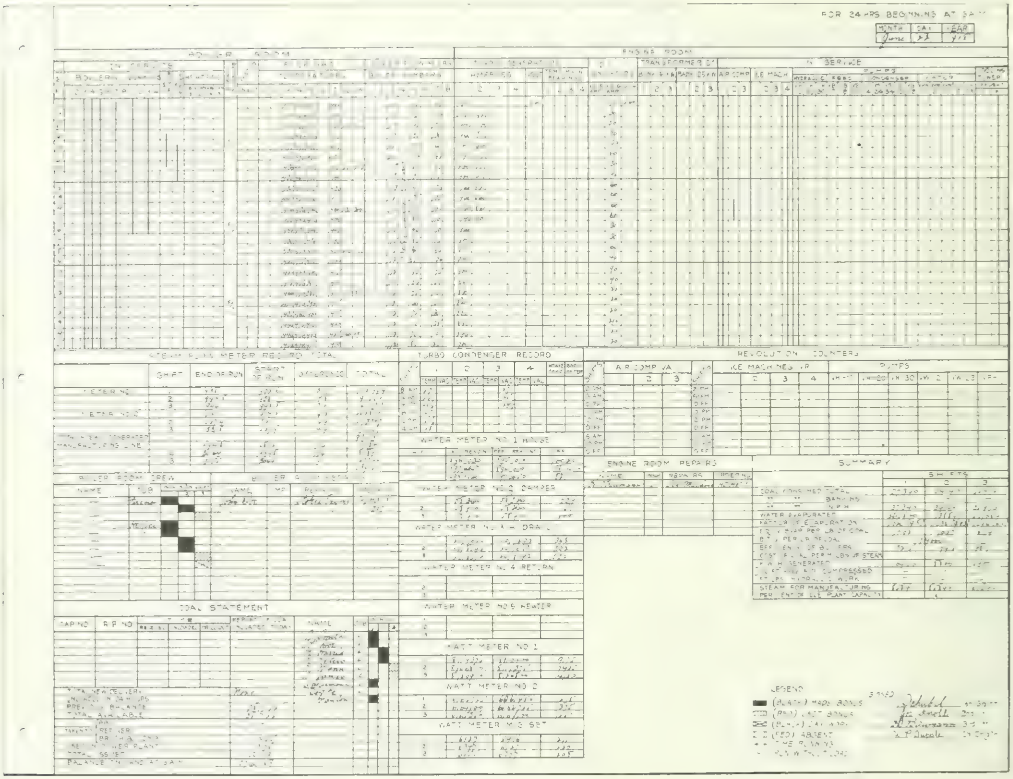


FIG. 27. SPECIMEN LOG OF ONE DAY'S RUN AT A POWER PLANT

guesses as to causes; thus a ratio of pounds of coal per kilowatt hour constitutes neither a record of performance nor of equipment efficiency. In the first place, say, three pounds of coal per k.w.h. may represent 30,000 B. t. u., or 42,000 B. t. u. input. If we express the ratio in heat units per k.w.h., say $\frac{35{,}000 \text{ B. t. u.}}{\text{k.w.h.}}$ we must know how many heat units are needed in a given plant under perfect condition of equipment and under a proper method of operation before we can tell at all what the record means. If $\frac{28{,}000 \text{ B. t. u.}}{\text{k. w. h.}}$ is the practical aim to be strived at, the record discloses 25 per cent. loss, part of which may be due to poor maintenance and repair of equipment while another part is caused by wrong operating practice. Again, k. w. h.'s are born neither as Pallada from Zeus's head, nor as Diana from a shell, ready made in all divine beauty and glory; rather the coming of a k. w. h. could be compared with a butterfly whose appearance in its final form is preceded by a long and tedious metamorphosis from an egg to a caterpillar, then into a chrysalis in a cocoon, and only when she leaves Nature's womb is she ready to perform her brilliant feat. Likewise our k. w. h. passes through several stages of transformation before it takes the form of electrical energy. The record for disclosing preventable losses in the transformation of energy (transformer), before it may be regarded as a piece of actual, useful information for elimination of this waste, must be able to allocate:

1. The stage in which the loss occurs.
2. The cause of inefficiency.

Let us assume a steam-electric power plant, the inherent efficiency of the principal units of equipment being as follows:

Stage	*Efficiency Per Cent*	*Process*
Boiler plant (including all auxiliary)	75	(Transformation of thermo-chemical energy of fuel into volume energy of steam.)
Turbine room (including all piping and auxiliaries)	15	(Transformation of volume energy of steam into dynamic energy on shaft.)
Generating room (including exitation and transformation)	80	(Transformation of dynamic energy into electrical energy.)
Entire plant	9	(Entire process.)

The cumulative effect of losses is plainly apparent, it stands in dependent sequence to each preceding process since loss sustained in a previous stage reduces the energy available for the following process. Only nine per cent. of the heat energy available in the coal is finally transformed into electrical energy available on the outgoing feeders if this plant is operated perfectly, *i. e.*, if the equipment develops under operating condition continually the maximum energy it is designed for. These nine per cent. represent 37,910 B. t. u. input to one k. w. h. plant output, which is theoretically equivalent to 3412 B. t. u. Leaving aside this enormous waste of natural resources caused by our crude and imperfect way of designing and building power generating equipment, let us consider the effect of improper use of what we have. Suppose that our record actually shows that 48,750 B. t. u. in the shape of coal are used to generate one k. w. h. Comparing actual performance with possible task figure we learn that our operating methods caused about 30 per cent. loss. Now comes the questions, Where does this loss occur? If our record is complete, it would show a picture like this:

	Efficiency		
	Possible	*Actual* *In Percentage*	*Loss*
Boiler plant efficiency	75	56.5	24.66
Turbine room efficiency	15	14	6.66
Generating, transformation, etc., efficiency	80	79	1.25
All around plant efficiency	9	6.25	30.5

To analyze further the significance of these records, we must possess accurate information as to what causes the loss in each stage of the process.

The loss in steam generation may be produced by excessive or insufficient draft, poor attendance to the fuel bed, neglect to keep heating surface clean, etc. The loss in the turbine room may be due to a failure of apportioning the load to different units so as to take advantage of the lowest region of the water rate curve, or neglected vacuum or poor condition of blading or auxiliary mechanisms, or what not. Similarly excessive electrical losses may be caused by factors that are just as much within the control of the management as these mentioned as examples in boiler and turbine rooms.

Collecting Data

Referring now to the mode of securing the records, that is, collecting the information, the first thing to be considered is the accuracy and continuity of records. Readings taken from instruments that are out of adjustment, clogged or installed or connected in the wrong place, might be safely dispensed with. In the chapter on maintenance, due stress was laid on the importance of care of instruments and a method of inspection and checking was briefly outlined. The *continuity* of records of a certain nature or under special circumstances does exceed in importance almost everything else. Readings taken at considerable intervals do not represent the fact, neither as to the quantity nor as to character, since the occurrences between the readings are not taken into account. If we plot a curve representing the continuous record, we may find that the periods of readings may fall on the points above or below the average. A record of a very large public utility boiler house which was shown to me some time ago, apparently indicated that an average ashpit pressure maintained there was about 2½ inches of water. When an attempt was made actually to see this pressure continually kept, it was found that the fan would be shut down approximately every seven minutes, yet the combustion engineer regarded it a bad form to take and record a reading while "Jack was down," recording only the readings at full speed of the fan. On the other hand, for reason of a purely psychological nature, readings taken by a man at sufficiently frequent intervals have certain and specific advantages over automatic records. While each case should be judged on its own merit, the most reliable manner of securing data is a combination of periodic readings of indicating instruments by attendants and recording the observations on a log, while the chief engineer or superintendent of the plant gets for his information, and permanent records also, from the charts of automatic instruments.

Use of Performance Records

The performance records, secured one way or another serve two distinct purposes:

First, while the readings are being taken to direct the work of the attendant in properly adjusting the operating conditions, and,

Second, after they are recorded for analysis of performance as to (1) results, (2) living up to instructions, (3) deterioration of equipment, (4) suitability of materials and supplies.

It is of the utmost importance, therefore, to devise a suitable form of a power plant log, individual as the plant itself and, above all, not to spare efforts in keeping and analyzing it. The three examples of actual logs here reproduced (Figures 27, 28 and 29) cover a wide stretch from a small industrial boiler house to a public utility plant and electrified railroad central station.

As anything so detailed and complete as the elaborate large log is liable to be filed away before the man in charge of the plant operation gets the benefit of its study, a concentrated summary on the log or on a separate slip, Figure 30, should be made for the quick information of those interested primarily in the results, while any further information could be secured from the complete log, instrument charts, etc., whenever a detail study of operating conditions is needed.

As it has been said in regard to men's performance the record of their living up to their task must be analyzed before the same crew comes back to work in order to secure the benefit of experience and prevent the recurrence of mistake (see Figure 31), so it is with the general performance records. In fact in few cases only can the judgment as to man's performance be formed without a close study of all the conditions under which he performed his work—hence the analysis of all records in practice does not follow, but precedes, the determination as to whether the bonus was earned. The amount of work required is by no means large or prohibitive even for a small industrial plant, but the benefits derived from such close study, leading to continuous improvements and prevention in the very beginning of any deterioration of efficiency, are so large as to warrant the employment of a well paid, highly trained engineer, with a keen analytical mind. In our experience such scrutinizing and summing up of the day's log and other records usually takes but a small fraction of the time of a study-man or planning engineer. The balance of his time is utilized in further experimentations and training of help.

For the purpose of further reducing the time consumed in calculations involved in summing up and determining efficiencies, various ratios, etc. and in order to avoid tedious and unreliable references to tables, a set of well drawn diagrams or a slide rule may easily be prepared. The use of such devices, Figures 32 and 33, not only insures much greater speed, since a sufficiently correct interpolation can be made from a conveniently plotted curve more quickly without the need of further figuring. The accuracy of the results is at least as high as that of the instruments furnishing the basic data.

The analysis of records covering the conditions and results of operation gives the clue to the real mastering of power production. Opinion and judgment have no room or excuse since it is obvious that any guess not based on the positively established facts has at least as many chances to be false as to be right. When, however, we take into consideration that in all guess work opinions are formed not on the basis of all influential factors but on the most conspicuous ones only, it becomes evident that omission of one factor, or a wrong assumption of any, necessarily leads to a false conclusion. The empirical proof of this statement is obtained in every case where full records are not kept or, if kept, are not properly used.

In such plants a large margin for economy is invariably present. The writer emphasized this fact at the annual meeting of the American Society of Mechanical Engineers in 1917 suggesting the establishment by the United States Fuel Administration of a priority ruling on coal deliveries to those concerns that *have* and *use* their records correctly. The United States Fuel Administration in a circular letter of June 12 admitted this viewpoint by announcing the appointment of inspectors for investigation of the operating efficiency of power plants. A new principle is hereby accepted, though not yet clearly formulated, that *the natural resources of the people may be entrusted only to those who know how to use them for the public benefit and prove that they have that knowledge,* while those who recklessly and selfishly waste the national wealth are denied the opportunity to benefit themselves at the expense of the people.

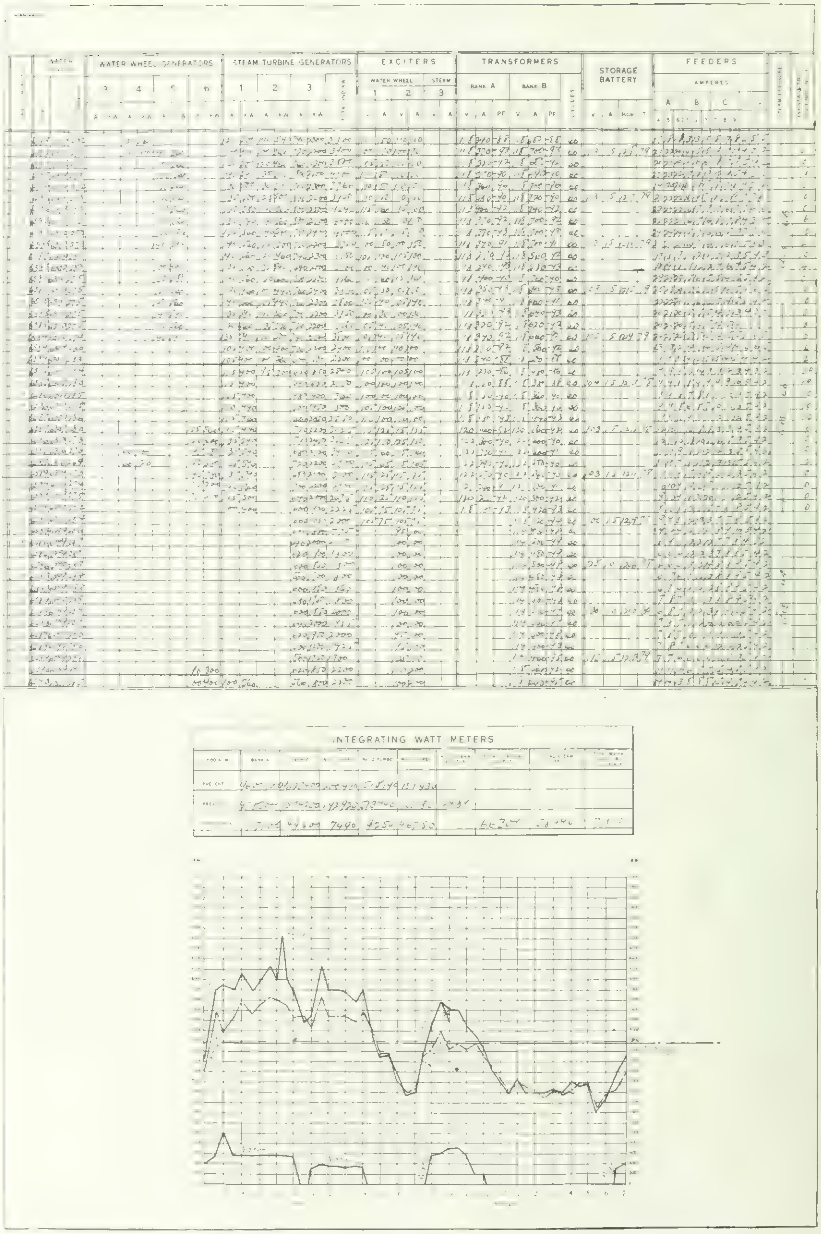
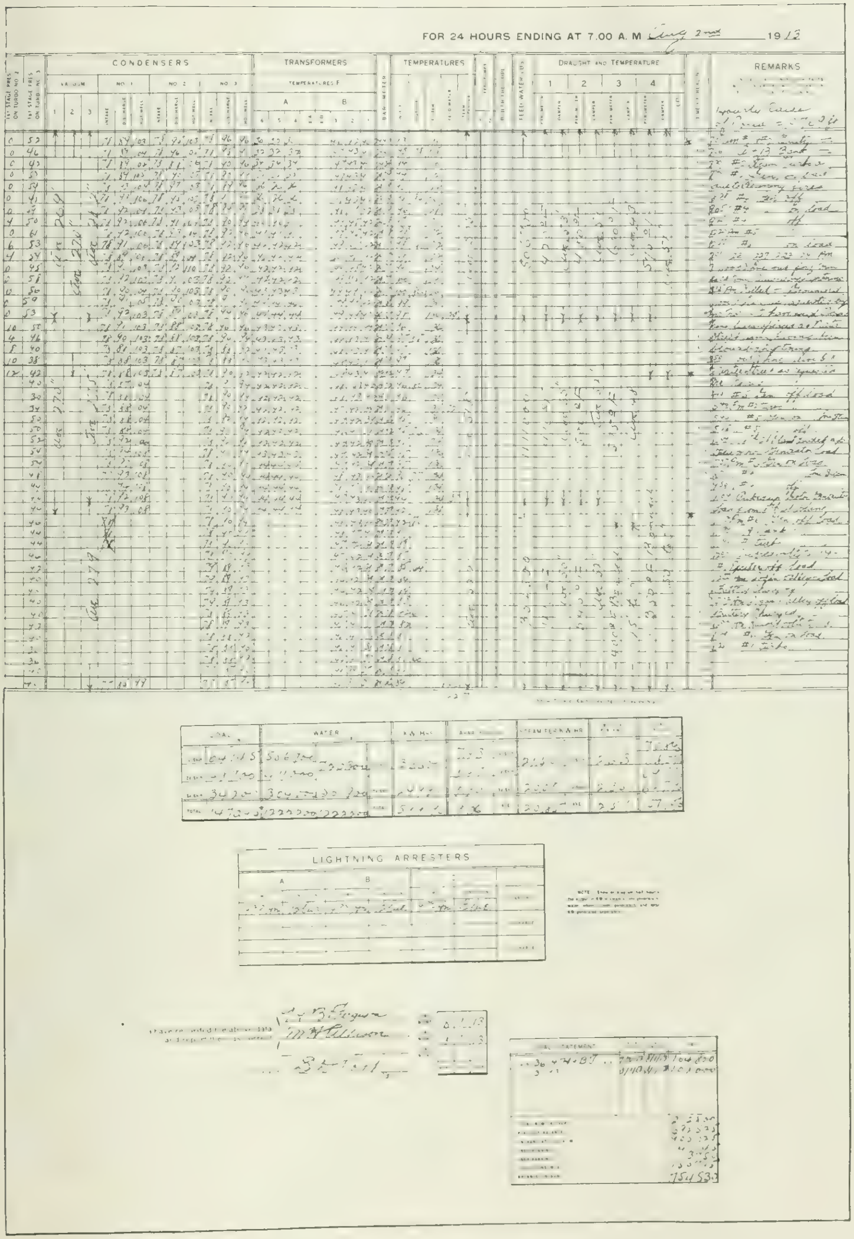

WATER WHEEL GENERATORS
STEAM TURBINE GENERATORS
EXCITERS
WATER WHEEL
STEAM
TRANSFORMERS
BANK A
BANK B
STORAGE BATTERY
FEEDERS
AMPERES
INTEGRATING WATT METERS

FIG. 28. TWENTY-FOUR-HOUR LOG OF POWER PLANT WITH STEAM AND HYDRAULIC TURBINES

AID OF MAINTENANCE RECORDS

In the chapter on maintenance of equipment, a reference to maintenance records was made. Here it is sufficient to point out the close relation between operating and maintenance records as both are often unintelligible without another. Low operating efficiency may be, and frequently is, inevitable when the upkeep of equipment is neglected. Instructions may be lived up to scrupulously; records will indicate that the operating force adjusts all conditions closely and correctly, yet the records of results will disclose a loss if compared with the possible and required aim. In the face of such contradiction of records it is not possible to establish definitely the cause, and it is even permissible to question the veracity of statements and accuracy of instruments. A reference to records of maintenance and inspection would throw light on the fact that with the condition of the equipment nothing else could be expected. *Vice versa,* the apparent inconsistency of operating conditions and results obtained often discloses the necessity of overhauling, repairing, cleaning and



FOR 24 HOURS ENDING AT 7.00 A. M Aug 2nd 1913

CONDENSERS

TRANSFORMERS

TEMPERATURES

DRAUGHT AND TEMPERATURE

REMARKS

LIGHTNING ARRESTERS

Fig. 28. Continuation of log shown on opposite page.

adjusting, the equipment used. For example, an increased coal consumption per k. w. h. may be definitely allocated to the turbine room through operating records, yet the record of distribution of load is correct and a smaller quantity of steam should suffice, also an examination of all auxiliaries does not indicate any trouble and the temperature of condenser intake and discharge is normal. The cause of the increase is indicated by the maintenance record, which shows that the condenser tubes were long overdue in cleaning, their changed conductivity, though greatly reduced, was not shown by the temperature of the discharge water as the thermometer pen was out of adjustment, but the cause of the low vacuum was thus accounted for.

Again, in another case, low evaporation with obviously correct method of firing pointed out a wrong adjustment of the nozzles of the soot blowers by gradually increasing the temperature of the flue gases.

Records of Distribution

The distribution of energy, generated in a plant for different purposes, is equally important and quite indispensable for economical business, though the leading idea is somewhat different. In this we may consider two propositions: First, to account for different kinds of energy generated at the plant; second, to account for various uses or customers receiving the power. In an industrial power plant generating electric, pneumatic, hydraulic and direct mechanical power, besides furnishing refrigeration, live and exhaust steam for manufacturing processes, etc., it is sometimes a vital problem to find out the corresponding efficiency of each kind of

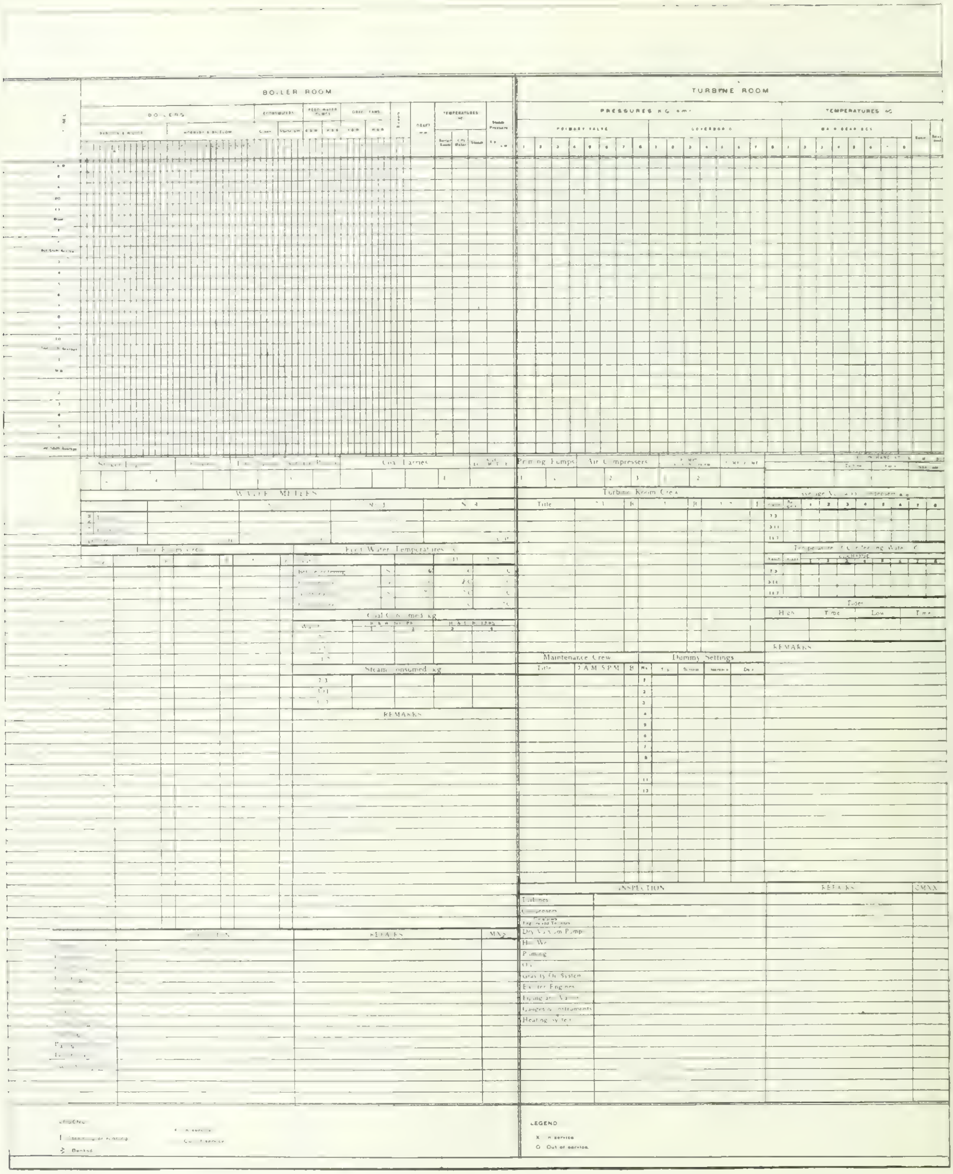
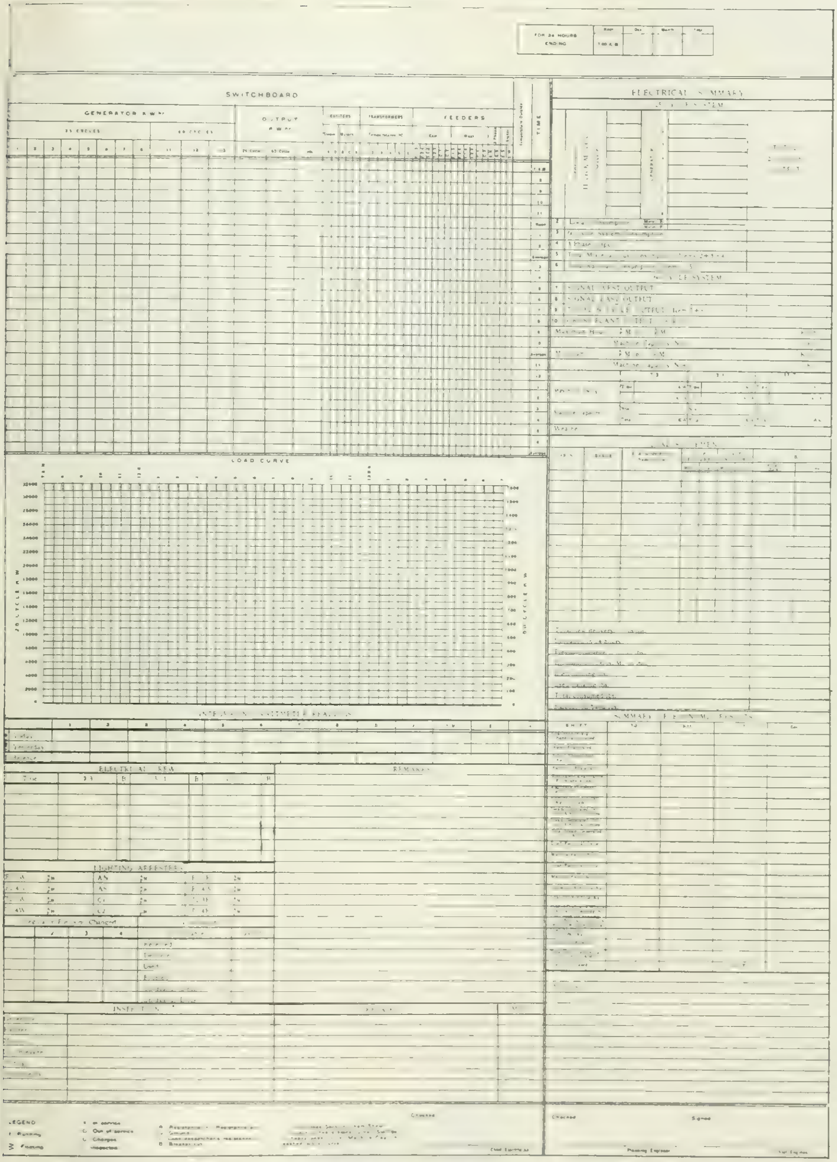

BOILER ROOM
BOILERS
TEMPERATURES
TURBINE ROOM
PRESSURES
TEMPERATURES
PRIMARY VALVE
WATER METERS
Turbine Room Crew
Feed Water Temperatures
Coal Consumed kg
Steam Consumed kg
REMARKS
Maintenance Crew
Dummy Settings
Priming Pumps
Air Compressors
Title
INSPECTION
REMARKS
Turbines
Condensers
Dry Vacuum Pump
Hot Well
Priming
Gravity Oil System
Exciter Engines
Piping and Valves
Gauges & Instruments
Heating System
LEGEND
X In service
O Out of service
LEGEND
Banked

FIG. 29. ANOTHER POWER PLANT LOG FROM A LARGE ELECTRIC RAILWAY LINE

power, and thus furnish the basis for determining relative economies in their use. In many instances the departments using certain kinds of power are not at all certain that, say, compressed air jib hoists are better than electric, or that mechanical shaft drive is cheaper than motor drive. Similar questions are becoming particularly important in shops where substitution of one kind of power by another does not require change of equipment but merely methods. Again no change of equipment should be decided upon unless the cost of service is firmly established. Most all the tests and calculations are misleading, inasmuch as they do not account for leaks and other losses in distribution and use which might entirely upset the cost of generation alone. Accurate records of such a nature are capable of throwing the correct light on the problem. Figure 30 shows that in a large machine shop, after the efficiency and cost of different forms of power were studied from a set of comprehensive records, efforts were made to use a least expensive form whenever and wherever possible. The result was a very material reduction of power-plant expenses, although some of the



SWITCHBOARD

GENERATOR K.W.H.

OUTPUT K.W.H.

FEEDERS

TIME

ELECTRICAL SUMMARY

LOAD CURVE

REMARKS

LEGEND

FIG. 31. CONTINUATION OF THE FORM SHOWN ON OPPOSITE PAGE

of electric power. Furthermore, in a similar way to the previously discussed graphic records of idleness of generating equipment or operating logs, records of feeder operation, interruption of service, length and cause of interruptions, are most serviceable. Figure 31 represents one such daily record. The study of the summary was found serviceable in developing the improvements materially reducing the main cause of interruptions.

CONSTRUCTION RECORDS

The effect of rapid construction or alteration of plants on its first cost is not always clearly realized. It is reported that in academic cloisters sometimes time passes unheeded, but the plans laid out for productive work or for construction of means of production without due regard as to time consumed are of no use.

Perhaps managers of capital would recognize clearly enough the disadvantage of slowing down the completion of the work from two to three years in order to gain 42 per cent. instead of 34 per cent. upon the fixed capital. But when the question lies between different lengths of time spent under a year, for instance between three, four or five months, it is frequently the case that the advantage of quick work remain wholly unrecognized and neglected[2].

It is of importance therefore to lay out the schedule

departments had a somewhat larger power bill than when it was lowered at the expense of other departments.

In a plant manufacturing electricity for sale a complete set of records differentiating between direct and alternating current as well as between 25- and 60-cycle output of the latter are almost always kept, though not always properly used. As a result in determining the bus-bar cost these differences are frequently disregarded and the customers' rates are not necessarily adjusted according to the cost of manufacturing various forms

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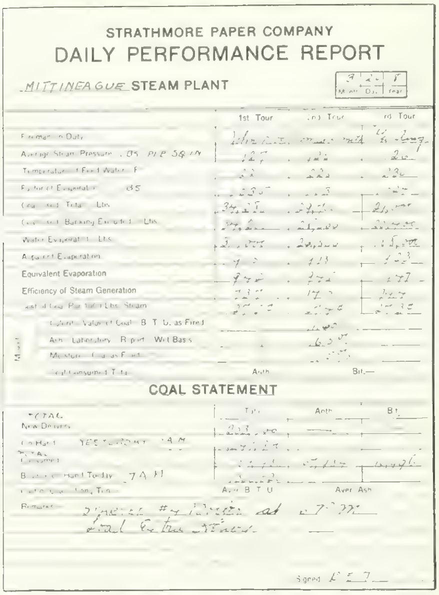
[2] See "Commercial Steam Power Economy" by R. H. Smith, London, [illegible]



STRATHMORE PAPER COMPANY
DAILY PERFORMANCE REPORT
MITTINEAGUE STEAM PLANT

Month Day Year

1st Tour

Equivalent Evaporation

Efficiency of Steam Generation

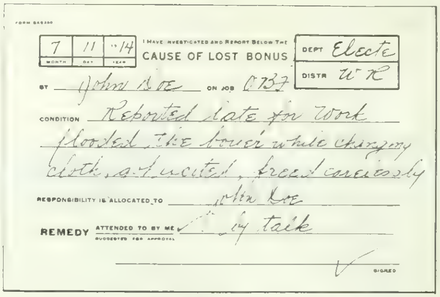
COAL STATEMENT

Anth Bit

Aver. B.T.U. Aver. Ash

Signed

FIG. 30 BRIEF REPORT FOR RAPID INSPECTION



7	11	'14
MONTH	DAY	YEAR

I HAVE INVESTIGATED AND REPORT BELOW THE
CAUSE OF LOST BONUS

DEPT Electc
DISTR W K

BY John Doe ON JOB 0737

CONDITION Reported late for work flooded the boiler while changing cloth, excited, treed carelessly

RESPONSIBILITY IS ALLOCATED TO John Doe

REMEDY ATTENDED TO BY ME / SUGGESTED FOR APPROVAL by talk

SIGNED

FIG. 31. REPORT FORM FOR INDIVIDUAL EMPLOYEE

carefully for work contemplated, and definitely determine the *task as to time* when materials shall be delivered, which operations precede and which follow and when each shall be completed. This obviously is not all. "The road to hell is paved with good intentions," and we should have a clear, continuous record of progress if we want to know whether we are living up to our task and if not, where and how much, we are behind the schedule.

Now, during this war, the oldest saying that "time is money" is supplemented by the one "time is blood." Waste of time in any activity gives advantages to those who do not wait and this means more than financial competition, it means death. The whole trend of our progress, the entire development of our technic is characterized in two words, "time saving." From high-speed steel to the fastest aeroplane, from shorthand notes to wireless telephone, everything is calculated to accomplish the most in minimum time. Since sanitation, hygiene and medical arts are as yet hardly able to appreciably prolong our life, it became a task of an engineer to make it possible for one to accomplish most within his limited lifetime.

Records of Men

Before we can pass our subject, a brief reference to the records of men's performance is indispensable. In the preceding chapters we had occasion several times to discuss and illustrate various means of presenting the attainments of individuals and groups; these were concerned with perfection of operation and excellence of results. As performance records are incomplete without maintenance records, so are men's records lacking unless accompanied by records of (1) health, (2) earnings and (3) habits. While these are pretty well reflected in their bonus records, it is sometimes advisable to take more pains to analyze closely the contributing factors to the success or failure of the most precious and important means of production—the mental and physical labor-power.

At the time of presentation of my paper on "Task setting for firemen" before the American Society of Mechanical Engineers in 1913, a discussor called attention to the omission of the question of selection of men. This problem of employing fit men is quite distinct from this one of fitting employees for their jobs. While it is unquestionably true that the performance of the plant depends on the initial quality of the attendants, it seems to be of greater importance to find

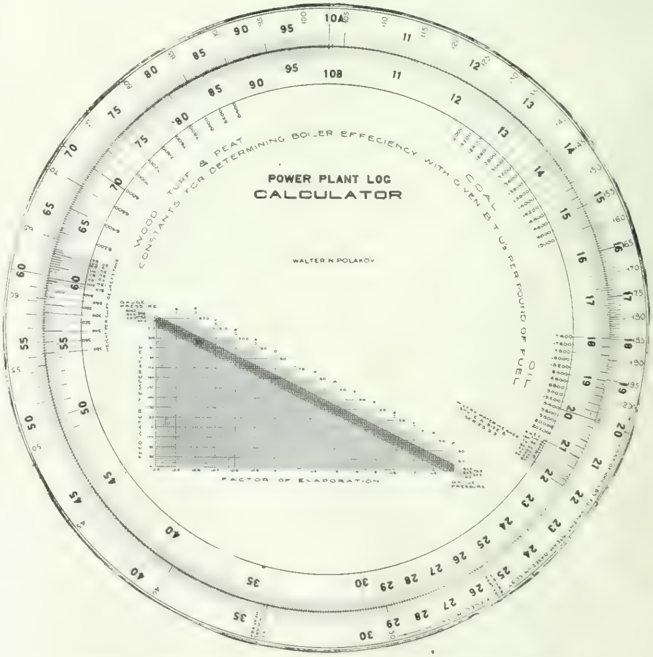
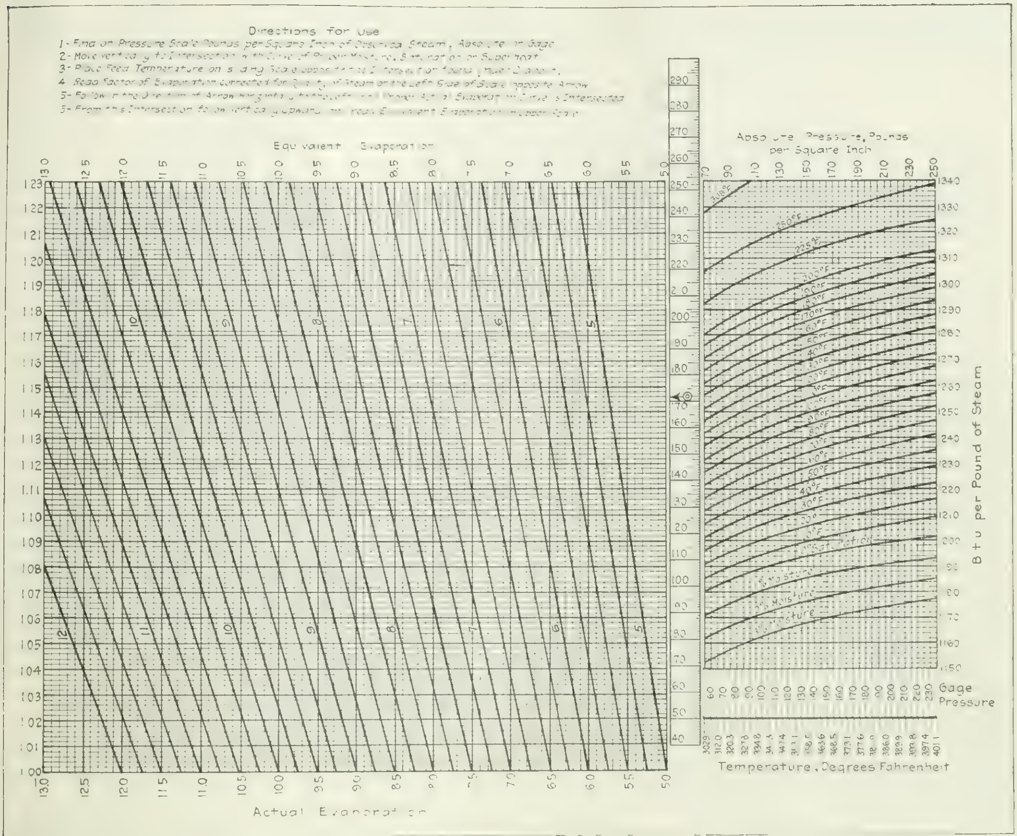


FIG. 32. A CONVENIENT CALCULATING DEVICE FOR THE POWER PLANT



Directions for Use

1- Find on Pressure Scale Pounds per Square Inch of Observed Steam, Absolute or Gage
2- Move vertically to Intersection with Curve of Per cent Moisture, Saturation or Superheat
3- Place Feed Temperature on sliding Scale opposite the Intersection found under 2 above.
4- Read Factor of Evaporation corrected for Quality of Steam on the Left Side of Scale opposite Arrow
5- Follow in the Direction of Arrow horizontally to the Left until Proper Actual Evaporation Curve is Intersected
6- From this Intersection follow vertically upward and read Equivalent Evaporation on upper Scale

FIG. 33. RAPID CALCULATING DEVICE FOR DETERMINING THE EQUIVALENT EVAPORATION UNDER DIFFERENT CONDITIONS

the way for overcoming the obstacles presented by difficulties, or even at times impossibility, of hiring men with all the desired qualifications. Under the present social conditions men seek employment primarily because of wages offered, and everything else is usually regarded as contributing or damaging incidents. Vocational training is still in its infancy so far as power house help is concerned.

Organization for supplying trained help, in order to become an effective factor, must be nation-wide in its activities, and its scope of work should embrace the daily gathering of information from the entire country as to men and jobs available, wage fluctuations, cost of living and conditions in various localities and industries. On the basis of these facts the machinery must be able quickly to shift surplus men from one state to another where there is a need for them, having transportation and accommodations prepared and provided beforehand for the volunteers. By an elaboration of such a plan, the problems of unemployment, inadequate wages, poor working conditions, etc., may be successfully ameliorated. The crowning success of such an organization would be the classification of all available men so as to meet intelligently the specifications for the industrial positions. As the matter stands now in this country, any employment manager could testify that the applicants for a job of fireman are willing to take most any job, if it pays better or is more pleasant. On the other hand, the only three qualifications for fireman's job that are recognized—strong physique, previous experience and state license—are as vague as unessential.

If a concern has a chance at all to choose whom to offer the vacant position of, let us say, a fireman, somewhat different peculiarities should be looked for. The first test must be this of the endurance of the man's attention, an untiring ability to notice the minute changes surrounding conditions; second, a resistance to influences which tend to distract fixed attention and, third, general good health, more particularly, ability to resist changes of temperature and strain on the eyes. All other qualifiations are chiefly local, depending on dissimilarities of plant equipment and lay-out, as for instance, in a hand fired boiler-room a short fellow is preferable to a tall one; in a stoker fired plant, muscular strength is non-essential particularly if special men clean the fires and ash-pits. Again, previous experience is often a decided disadvantage in a plant where no special provisions are made for a thorough training of new men on the basis of established facts. The old habits acquired under dissimilar conditions of previous employment may prove to be wrong for the new job. Locomotive firemen usually fail on stationary boilers, men accustomed to steady load take a long time to get used to work in a plant where load frequency fluctuates, etc. But above all the requirement for a license is to be deplored, fixed by law-makers for reasons obscure to themselves, examinations do not put any stress on the most important requirement—the knowledge and experience in economical generation of steam. Regulations as to safety are more properly within a domain of the watch engineers and familiarity with dimensions, proportions and features of design of boilers could be safely left to draftsmen.

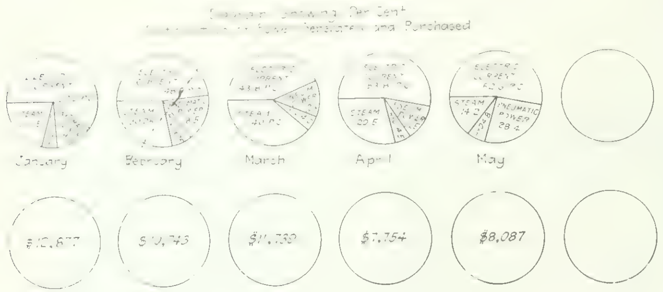
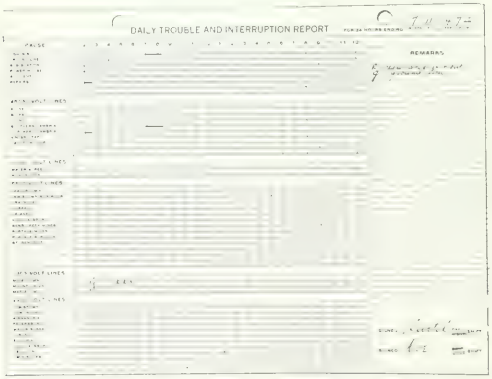


FIG. 34. DIAGRAM APPLICABLE TO A POWER STATION FURNISHING DIFFERENT KINDS OF ENERGY


DAILY TROUBLE AND INTERRUPTION REPORT

REMARKS

FIG. 35. CONVENIENT FORM FOR RECORDING TROUBLES

Another bad trait of those employing men is to ask for references, which is a pretty sure way of falling a victim of the prejudice of the previous employer, thus losing the opportunity of hiring a really good man who was merely unfit for the surroundings of his last job.

The basic cause of losses due to hiring poorly fitting men seems to be in the lack of attraction offered to the better grade of applicants; again, the losses due to a large turn-over of power-plant employees is chiefly due to dissatisfaction with some condition of employment—it may be treatment, hours or wages, but whatever it is, we must realize that frequent changes of positions is as much of a disadvantage to the employee as to the employer.

When, however, the operating practice is standardized and provisions for "filling" vacancies and training of the new employees are properly carried out, both causes of loss are greatly minimized. First, the new man is put to work under the best conditions that the ingenuity of management and coöperation with employees has devised, which, as a rule, is more desirable financially and otherwise than is an average old-fashioned plant. Secondly, if the employer does not look for a "ready made man" but is prepared to start him from the beginning with helpful training, the long period of wastefulness while the new man adapts himself to the new requirements (if indeed he can do so without systematic and persistent instructions, encouragement and help) is not only greatly shortened but when he acquires the new habit, he works not "as good as he can" but as good as the management knows how. Whatever forms are used to keep the man's record one consideration is paramount and that is that the *man's record reflects the ability of the management to lead its men.* If men do poor work or are not steady it spells *incapable leadership.*

VALUE OF RECORDS

To sum up this brief outline of essentials of plant records I can say without exaggeration that the best methods of statistics and the most excellent record keeping is of no avail unless it is used. No man, no machine, no time is of any value unless use is made of it. The most fertile soil produces but weeds unless it is cultivated. Yet the use may be in the wrong as well as in the right direction. Similarly, a collection of records is a dead ballast, or at best a mere potentiality of no more value than a locked up library, until there is someone to read the significance of its contents and use the knowledge gained.

(To be continued.)

Relining Our Guns in France

ANNOUNCEMENT is made by the Ordnance Department of the plans for the manufacture of the machine tool equipment which the United States will install in France for relining the heavy railway mount guns from 8-inch, to 16-inch, up to 50 calibers.

Owing to the tremendous heat generated by these guns when fired, their accuracy cannot be assured after a few hundred shots, unless they are relined. It was necessary, therefore, to establish a relining plant in France, where this work could be done.

The project for this relining plant is one of the largest undertakings by the Ordnance Department and will call for the expenditure before completion of from $25,000,000 to $30,000,000. The plant will be comparable in size with the Krupp Gun Works at Essen.

The machine tools alone required for this project will cost between $15,000,000 and $20,000,000 and embrace some 218 units, including gun boring lathes, engine lathes, rifling machines, and grinders.

Included among the facilities required for the manufacture of these tools, was a planer of unprecedented length—500 feet—to cost $450,000. The largest planer previously built was 186 feet in length.

The 500 foot planer extends over such a length of ground that in order to insure its perfect alignment a correction had to be made in the design to take care of the curvature of the earth.

The outstanding feature in the construction of these planers is the use of reinforced concrete for the bed plates. This results not only in a very material reduction in the time required to build the all important item—but also reduces the cost and saves iron for other war industries.

Putting Our Merchant Ships on Schedule

How the Principles of Industrial Management Have Been Applied in Controlling Ship Movements

By L. P. Alford

Editor Industrial Management

The ship that is not carrying cargo is idle, and the idle ship is useless so far as the United States Shipping Board and the people of the United States are concerned. To keep a ship at work, to prevent idleness, all ship movements must be controlled. To give the facts necessary for control, information in regard to cargoes that must be carried and those that have been and are being carried is plotted on a Gantt progress chart.

THE use we make of the shipping we have is of equal importance to the building of new ships. Every step taken toward improving the method of handling the ships which are already afloat is equivalent to adding a definite amount of deadweight tonnage built new, and it has the great advantage of being available now instead of in the distant future, for although we have become used to hearing of ships being built in less than a month, the gathering of the materials out of which the ship is built takes many months. Vessel after vessel has in the past been carrying cargoes which in war time are not of real value to this country — goods that we can do without or which are produced in sufficient quantities in the United States. Taking these vessels off less essential trades and giving them the job of bringing in necessary raw materials such as nitrate or sugar, is doing as much toward winning the war as appropriating money to build twice the number of new ships.

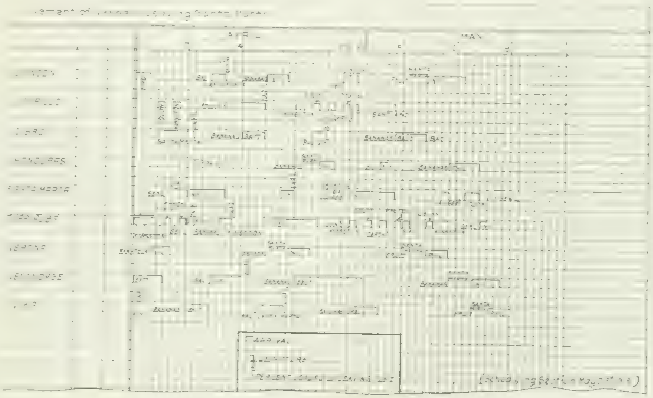


FIG. 1. SPECIMEN MOVEMENT SHEET FOR SHIPS

Routing cargoes to the proper piers, introducing labor-saving devices for unloading and loading cargoes, carefully planning and executing repairs—all the many things which can be done to expedite the movements of both steam and sailing vessels are adding just so much tonnage day by day to our fleet of cargo carriers.

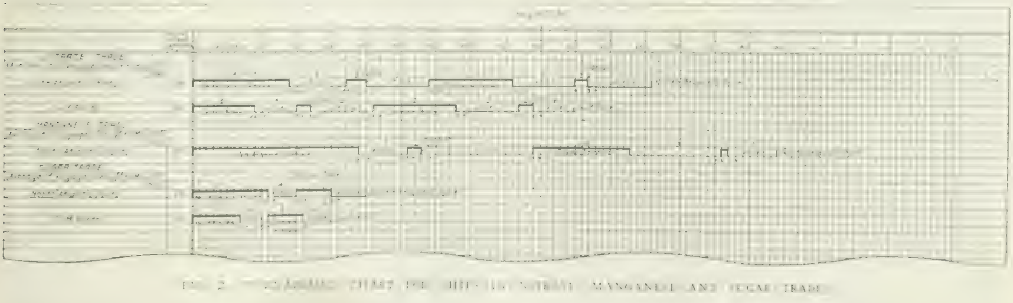


FIG. 2.—PLANNING CHART FOR SHIPS IN NITRATE, MANGANESE AND SUGAR TRADE

HOW THE WAR HAS CHANGED THE SHIPPING SITUATION

Even before the entrance of the United States into the war, shipping had undergone great changes; submarine losses had greatly decreased the number of ships in existence; the concentration of millions of men along a narrow front focused the shipping of the world on that point; the production of foodstuffs in the Allied countries was suddenly decreased causing a greater demand for the transportation of food from overseas; the increased production of war materials in Europe created a greater demand for raw materials and consequently more ships to carry them. Gradually the shipping of the world has been drawn to the war magnet in northern France. The tramp steamers that used to wander up and down the Seven Seas hunting for cargoes have one by one been given definite jobs to do, pointing toward a definite end. Sailing vessels have scurried away from European waters and, beyond the reach of submarines, are doing their part in bringing into the United States foodstuffs and raw materials to be transformed into munitions.

Before we entered the war, our shipping was used primarily to export to all parts of the world raw materials and manufactured goods produced in this country and only secondarily to import goods we were in need of. This is now changed and the three jobs to be done by our ships are, in the order of their importance, as follows:

A. To carry troops, munitions and supplies to France and food to our Allies in Europe.

B. To import into this country what is necessary to feed our people, and the raw materials needed to carry on the war.

C. To export to foreign countries those goods that they must have in order to produce the raw materials we need and, after that, whatever commodities are wanted by the countries we buy from.

A. War Zone Shipping

The ships which carry troops, munitions and supplies to France are operated by the Army. Those which carry foodstuffs to France, England, Belgium, Holland and other European countries, those which carry coal to Italy, and the tankers which carry fuel oil to all our European Allies, are operated by the Shipping Board. There is, of necessity, the greatest secrecy maintained in the handling of these ships so no detail can be shown.

B. The Import Problem

The job to be done by the Shipping Board in the matter of imports is to bring in what we need with as few ships as possible, and then turn over to the Army for the transportation of troops and supplies all that can possibly be spared. Before this can be done several knotty problems must be solved:

What must be imported, that is, what commodities, in what quantities and during what periods of time?

What are the needs of the various government departments and of manufacturers?

What materials produced in this country can be substituted for certain things which have heretofore been imported? In other words, just what is the job to be done by the ships controlled by the Shipping Board?

What ships are available to do this job?

What have these ships done, what are they doing and what can they be expected to do in the way of bringing in these necessary commodities?

All these questions are answered by means of Gantt progress charts. Just as work is laid out for a certain machine tool in a shop, so is a job given to a certain vessel and the progress it makes on that job is charted just as it is in a factory. For the first time, the principles of industrial management have been applied to the handling of ships. When Mr. H. L. Gantt took up this work, he had already begun the installation of his methods in the Ordnance Department of the Army in following up the tremendous quantities of orders that had been placed, and in the Emergency Fleet Corporation showing the progress made on the building of individual ships. This work in the Ordnance Department was illustrated and described on page 99 of the February issue of Industrial Management.

Gantt Methods Applied to Imports

The way in which Mr. Gantt's methods have been applied to this import problem can best be understood from the charts on which the facts are recorded. Simplicity is the keynote of these straight line charts and the feature which distinguishes them from other charts is the fact that they indicate progress both as to time and amount. We are constantly reminded of the fact that in this war we are fighting against time and this is particularly true in regard to shipping. These charts visualize the passing of time—the job to be done by the ships is plotted as to time, and the progress the ships make day by day is laid out on the same scale. They show:

What the job is.

When it is to be begun.

When it is to be finished.

What progress has been made in the past.

What progress is likely to be made in the future.

These are not the methods of men who have spent their lives in shipping circles, but of an engineer who tackles the problem of world-wide shipping just as he would plan putting an order through a machine ship.

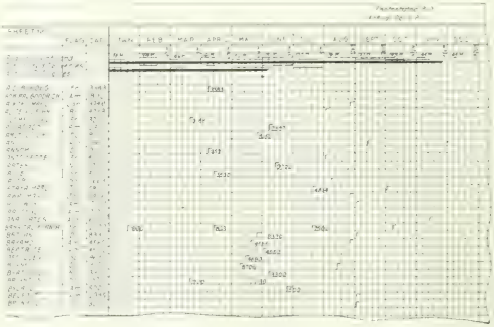


FIG. 3. SPECIMEN SHIP CHART OF COMMODITIES

Ship Movement Charts

Ships are of no use whatever except for the cargoes they deliver, and no two ships ever do a thing in the same way. They must be handled individually—not in bunches. In the Shipping Board, records are kept on ship movement charts of more than 11,000 vessels. Ships of every nationality are shown moving in and out of the nearest and most remote ports. They move up and down the Atlantic from Reykjavik to Tierra del Fuego, and from Antofagasta on one side of the Pacific to Vladivostock on the other. The chart illustrated in

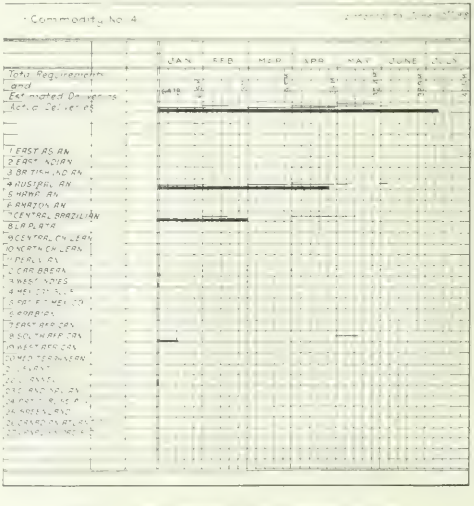


FIG. 4. AN INDIVIDUAL COMMODITY CHART

Figure 1 traces the movements of a few vessels in the fruit trade between Santa Marta, Colombia, and the United States. The key in the lower right corner shows the meaning of the plotted symbols. The ports at which the vessels touch, the time they spend in those ports, the time at sea, and the cargoes they carry, are all shown clearly and compactly.

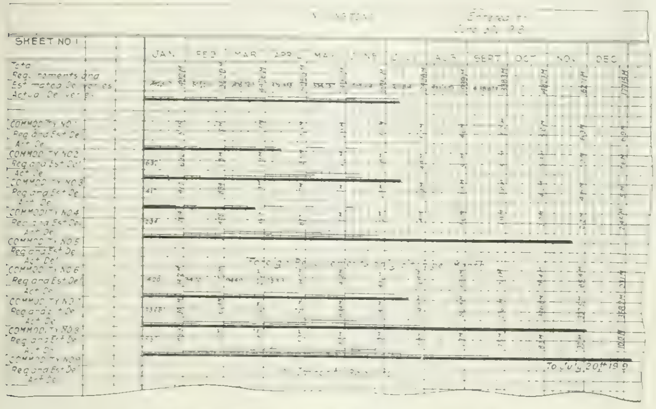


FIG. 5. SUMMARY OF COMMODITIES SHOWING STATE OF DELIVERIES

The purpose of these movement charts is to keep in one place all information in regard to locations and movements of vessels—the cargoes delivered depend on the movements of the vessels. The information entered on these records comes from various sources and in various forms: the daily report of the Naval Communication Service gives movements in all ports of the United States and its possessions; cables, some daily and some weekly, give locations of vessels in foreign ports. Every available source is drawn upon for this information.

Other government departments have cordially coöperated with the Shipping Board in securing information as to cargoes carried by the ships. The Shipping Board was experiencing considerable difficulty in securing the necessary, prompt information as to movements of commodities when the Department of Commerce and the Treasury Department came to its aid and offered the services of their seasoned and worldwide organizations. Hundreds of thousands of cargoes have been checked in and recorded by them and the information forwarded to the Shipping Board daily. They have even gone further and have digested the information and at ten-day and monthly intervals they furnish summaries to assist in planning the operation of our shipping.

"Turnaround" Chart:

The round trip, or "turnaround" as it is called in shipping circles, is the time it takes a vessel to do a task set for it—*i. e.*, the interval between the delivery of one cargo and the delivery of the next. Figure 2 illustrates the turnaround of vessels in the nitrates, manganese and Cuban sugar trades. This chart is, of course, based on the actual performance of vessels in these trades and its purpose it to furnish a basis for forecasting the dates on which vessels will deliver their cargoes. The figures above the lines indicate the time consumed in the various parts of the voyage (the delays in ports become immediately apparent) and the figures below the lines tell how many days are likely to elapse before the vessel delivers her cargo.

Ship Charts of Commodities

The chart illustrated in Figure 3 connects the individual vessels and the cargoes they deliver with the task that has been set. The angles opposite the various vessels indicate the time of delivery of cargoes; the figures in the angles indicate the tons of cargo delivered. The angles which contain no figures indicate the time of future arrivals, based on turnaround charts. In the absence of information as to the amount of cargo to be lifted, the capacity of each vessel, as shown at the left of the chart, is taken as the amount she will deliver at the time indicated by the angle.

At the top of the sheet, the horizontal figures show monthly requirements; vertical figures show cumulative requirements; light lines indicate monthly deliveries (the ratio of the length of the line to the monthly space is the same as the ratio of the delivery to the requirement); heavy lines show to what extent our present estimated or actual imports will meet our requirements. The purpose of this chart is to show the progress made toward meeting the requirements and to show the effect of allocating vessels to any particular trade or taking them off that trade.

Individual Commodity Charts

The number of commodities which it is considered necessary to import in view of the shortage of ships, is less than 100. For each one of these commodities there is a chart similar to the one shown in Figure 4 on which are plotted the amounts received from the 27 trade regions into which the world has been arbitrarily divided, all plotted on the same scale as the total. This chart was developed for the use of the experts who had determined the requirements so that they might be kept informed as to the import situation.

Summary of Imports

Figure 5 illustrates a few of the hundred necessary commodities placed one above the other. This

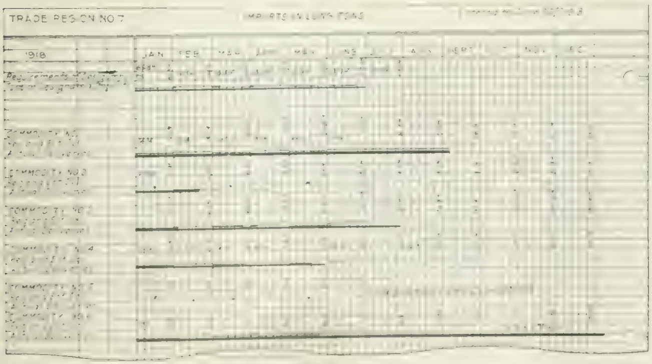


FIG. 6. SUMMARY OF IMPORTS [illegible]

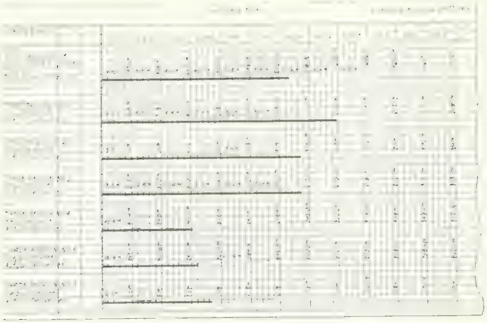


FIG. 7 — SUMMARY CHART FOR ESSENTIAL COMMODITIES

shows shortages of some commodities and of others, over-deliveries equalling many months' requirements. This chart makes it easy to compare the progress made on a large number of imports and presents the facts in such a way as to induce action. At the top of the sheet the import situation as a whole is shown in a single line.

INDIVIDUAL TRADE REGION CHARTS

From trade region No. 7 (see Figure 6) there are only six commodities which it is considered necessary to import. The progress made in importing these commodities from this particular trade region is plotted here. Inequalities become very apparent in this arrangement. The individual commodity charts showing the amounts of each commodity received from all parts of the world are studied with these trade region charts in order to get comparisons two ways. At the top of the sheet the situation in this trade region as a whole is plotted.

SUMMARY OF TRADES CHART

Figure 7 shows the situation in a few of the 27 trade regions. The first three show considerable over-deliveries while each of the second three is, however, from two to three months behind its requirements. It is evident that the next vessels arriving from the first three regions should be transferred to those regions in which the shortage is the most acute. The line at the top of the sheet shows the progress made on the trade regions as a whole and is the same as the line on the "Summary of Imports." It shows whether or not the vessels at the disposal of the Shipping Board are sufficient to bring in the necessary imports.

C. THE EXPORT PROBLEM

Exporting and importing are, of course, interdependent. In order to get nitrate for munitions and agricultural purposes from the mines of northern Chile, we must send down the coal and fuel oil needed to operate the mines and the railroads that bring the nitrate to the coast. Before we can get manganese for armor plate steel from the mines of Brazil, we must send coal for Brazilian railroads and coastwise shipping. If we do not send agricultural machinery and coal to the Argentine, that country cannot send wheat and meat to our Allies.

This export problem differs only in detail from the import problem and similar charts set forth the facts.

THIS WORK ONLY BEGUN

Everyone who is familiar with the basis of control methods in industry will be glad to know that these methods are being applied to the problem of ship handling, but the work has only been begun. Mr. Gantt has worked out a method of recording facts and presenting them in such a way as to induce intelligent action, and great progress has been made in assigning the vessels to the right jobs, but there is much more that can be done and must be done before we can truthfully say that our merchant marine is most efficiently managed. We must plan the movement of every ship sufficiently far in advance as to avoid any idle days.

The part immediately ahead of us in this war is to deliver in the front line trenches men and materials. We have a limited quantity of machinery and tools in our shops; a limited quantity of grain fields ready for cultivation; a limited number of freight cars and a limited number of ships. To allow any of these machines, these grain fields or these ships to remain idle day after day is to lend real aid to our enemies.

Pay the Income Tax in Installments

By J. P. Brophy

Vice President and General Manager,
Cleveland Automatic Machine Company

A FEW words on the income tax are appropriate at this time for the reason that we have all recently met our Government's requirements in this respect. It is no exaggeration to proclaim that collecting income taxes from business houses, forcing full payment at a certain date, is displaying a power by the Government that cannot be evaded.

I would like to ask if this is a sensible administration of the tax law. Liberty bonds are sold giving time to make payments to encourage purchasers. If this plan were not considered wise in Washington, it would never have been adopted. If full payment were demanded when the sale was consummated, bond selling would be more of a problem because the response from the business public would be lessened.

INSTALLMENT PAYMENTS WOULD BE EASIER

Why not pay the income tax in installments allowing two months to make the payment, as this would not demoralize general business to any great extent? What we need in this war is free interchange of dollars in business centers.

The officials in Washington must be on the alert not to perpetuate this condition while the war lasts. If income taxes were collected on a two months basis, 40 per cent. as the first payment and 30 per cent. on each additional payment, a sensible modification would be introduced.

It must not be overlooked that an enormous number engaged in big business should not be forced to pay large amounts at any fixed time, but the payment should be divided into different periods.

If this war lasts a year or more the Government must study this question seriously and encourage and assist the employers of men.

Right now collections are extremely slow. Those who always paid their bills on the tenth of the month, taking the two per cent. discount when offered, are not doing it at this time. I am not guessing at this, I know. I know that at least 80 per cent. of the companies are short of cash because the income tax has created a money shortage in business circles, and the only thing to do is to ask for an extension of time to meet obligations. This is not encouraging; and remember, this condition embarrasses the managers of all the companies it affects and creates a fear.

Some of the leading contributors to this magazine should study these two questions and give the readers of Industrial Management the benefit of their views, as honest agitation is a great solver of bothersome problems.

Keeping Track of Production

Methods Used With Gratifying Results in Making Implements

By H. A. Russell

The key of the methods described is a summary card—the production-operation cost record upon which is entered all of the vital facts in regard to the progress of every manufacturing order, and upon which is also kept a running inventory of all parts in stock. The data in regard to production come from the operation time card. At all times the summary card shows the standing of every production order and just how many parts of each kind are finished and placed in stock.

Mr. H. A. Russell *has been in charge of the cost department of A. B. Farquhar Company, Ltd., York, Pennsylvania, for the past 15 years. During that time he has directed the buying of supplies and materials, and planned and put into operation the business systems now used by the firm, the latter work being based on the study of systems and methods in other factories.*

MOST of us can remember when it was necessary to go out in the factory and interview every foreman, if we wished to know the standing of a customer's orders. In the majority of instances we found that certain departments were not in balance with the others. Some had their part of the order 90 per cent. completed, others from 20 to 50 per cent. Possibly one or more had not started on the particular order in which we were interested. The result was that instead of the order being nearly ready to ship, as the report of the leading department would indicate, the average progress was possibly 40 per cent. and the leading department would have their part of the order cluttering up valuable floor space weeks longer than necessary.

In other words the most progressive department was paying a penalty for being efficient, at least so far as it was concerned in the particular order we were investigating. The remaining departments may have been working to the limit of their capacities but not along the same lines. It was usually the case that certain departments were always behind, not because their capacity did not balance with the other departments, but because they always managed to finish the wrong thing first.

Another method of falling behind was to keep switching from one order to another. The foundry would start on a run of a thousand similiar castings. When several hundred had been molded, someone would butt in with an urgent request for castings from some other pattern. Possibly a week would elapse before the first pattern would get back in the sand again. The same kind of switching would occur in the machine shop, in the carpenter shop and elsewhere. The final result was, that while everybody worked hard, the maximum output could not be obtained.

Gradually better methods were adopted. Weekly meetings included the foremen and the heads of the sales and purchase departments. Consultation between the foremen was encouraged. The purchase department was furnished with more complete information, not only as regarded actual but prospective orders as well. Three departments that had a pronounced tendency to pull in separate directions were put in charge of one general foreman with the result that they all worked along the same lines in harmony. Finally the production department was created and all departments in the factory received their instructions from the production man. Naturally, improvements have been made in the methods first adopted by the production department.

Our Division Into 24 Departments

In this factory, which manufactures agricultural implements and heavy machinery, there are 24 departments. These are divided into productive and non-productive classes. First, in the productive class we have:

Gray iron foundry
Brass foundry
Machine shop for heavy machinery
Machine shop for implements
Blacksmith shop
Boiler shop
Sheet iron shop
Carpenter shop
Buffing room
Bolt room
Paint department
Box-making department.

In the non-productive class we have:

Drafting department
Pattern department
Tool room
Yard (loading and unloading)
Packing
Experimenting

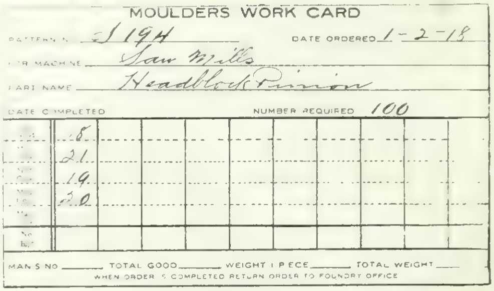
All of the productive departments as well as the pattern shop in the non-productive class, regulate and balance their work under the instructions received from the production department. In fact the only departments in which the production man is not directly interested are the yard, drafting and experimenting. The remainder of the 24 departments consists of the power house, warehouse, etc. Each department is known by a number. The product of the factory is divided into 17 classifications. Classification (1) covers engines and boilers, (2) traction engines, etc. All material and labor are charged against the proper classifications, by means of material requisitions and time slips, and the matter of ascertaining whether any or all classifications are profitable or not is considerably simplified. A factory may show a satisfactory profit at the end of the year on the entire output, but unless some means is provided to divide the output into groups, it is quite possible that one or more of the lines are being sold too close to cost or even at a loss.

The production department must keep in close touch with the incoming shipments of raw and finished materials. The purchase department should provide copies of invoices (minus prices) or shipping memorandums for all incoming materials and also pass along any item of information which will help the production man. On the purchase department, to a great extent, depends the success of the production department. This is true even in normal times and in these days of embargoes, slow transportation, greater proportion of lost and damaged shipments, priority orders and other matters which may affect the free movement of what we might call peace materials, as against war materials which are necessarily taking precedence, the production department needs all the information that can be given to it, not only actual shipment of purchased items but also receipts.

Production Information

To be capable of correlating the output of the separate units of the factory, the production man must have not only a knowledge of every part made in the entire factory but also of the capacity of each individual lathe, planer, milling machine, steam hammer and drill press, used in transforming the raw or semi-finished material into the finished parts. He must also know the assembling and erecting capacity of each gang of men employed in incorporating the individual parts into the completed machine. He must be able to balance the much greater speed of the woodworking department against the slower developement of the casting orders in the foundry, and the subsequent machining of these same castings. One of his important duties is to keep the foundry supplied with the proper quantity of duplicate patterns so that the desired quantity of castings can be supplied to the machine shop as required by that department. Irregular deliveries of castings from any one pattern mean a loss in the machine shop. If the quantities are not large enough, the operator on the machine will be switched around from one job to another, with a consequent loss of time between each run. If the quantities are too large the matter of extra handling enters into the calculation. The production man who can only visualize one casting at a time and cannot place it in it's proper position as affecting or being affected by other castings or parts, is doomed to failure as a successful production man. And the only way that he can keep posted on all the many items and their relation to each other, is through accurate records which reflect the true condition of each item, at the moment he refers to the record.

One of the first requirements of this department is a complete list of each and every part for each and every machine or implement made in the factory. These lists must contain all items, whether produced in the factory or purchased as finished units from the outside markets. These lists are usually prepared in the drafting department and include not only the quantities of each individual item required for one machine but also specify the kind of material, such as gray iron, malleable, steel castings, or the grade of the material, such as flange steel, firebox steel, hard or soft or plow steel. Sizes are necessary for plates, bars, bolts, belting, etc. The production department is not the only one benefited by these lists, they are needed also by the cost department. Before a single order can be issued to the factory, the production man must have some definite basis from which to plan. Where the line is at all uniform, the sales department should estimate the quantity of each style and size of machine that will be required during the coming season. The result is known as the "estimated sales" and a typewritten copy is sent to all departments interested. This includes the production and purchase departments. The purchase department analyzes its copy, and after consultation with the production man, prepares to buy or contract for all items that must be procured from the outside markets. Deliveries of purchased materials are arranged so that they will not be received too far ahead of actual needs.


MOULDERS WORK CARD

PATTERN N. S194 DATE ORDERED 1-2-18

FOR MACHINE Saw Mills

PART NAME Headblock Pinion

DATE COMPLETED NUMBER REQUIRED 100

8

21

19

20

MAN'S NO ______ TOTAL GOOD ______ WEIGHT 1 PIECE ______ TOTAL WEIGHT ______

WHEN ORDER IS COMPLETED RETURN ORDER TO FOUNDRY OFFICE

FIG. I. CARD USED FOR RECORDING FOUNDRY WORK

Production Department Methods

One of the first factory departments to receive instructions is the foundry. The production man and his assistants prepare the orders for the various castings, using the molders work card, Figure 1, for this purpose. However, before the quantities can be filled in on these blanks, it is necessary that the production man knows how many of the castings from each pattern are already on hand, and which were carried over from the preceding season. There are certain machines that are manufactured all through the year. Steam engines will be one of these. In the warm months they are sold to the agricultural trade, and in the cold months to the lumber trade. Unless some method of carrying a perpetual inventory is provided, there will be more or less guess work involved, and the consequence will be that the stock of the various castings will be over or under requirements. A large surplus of castings or other parts may mean a considerable loss at the end of the season, should it become necessary to change the design of the machine for the coming season. A shortage of parts means an extra run and will probably interfere with the output of some other needed implement or machine, usually at a time when interference means costly delay. Figure 2 shows the production-operation cost card, which is 15 inches long and 6 inches high, ruled and printed on both sides. The information contained in the spaces above the first double line is furnished by the production man. The name of the operation, the piece price and department number, is given by the time department. The actual count which is made at the time of taking the yearly inventory has furnished the greater part of the information needed to start the cards. Of course, a large number of cards are started during the year, as new items are constantly coming into production and, as the system is elastic, the new items do not interfere in any way but simply expand the influence of the

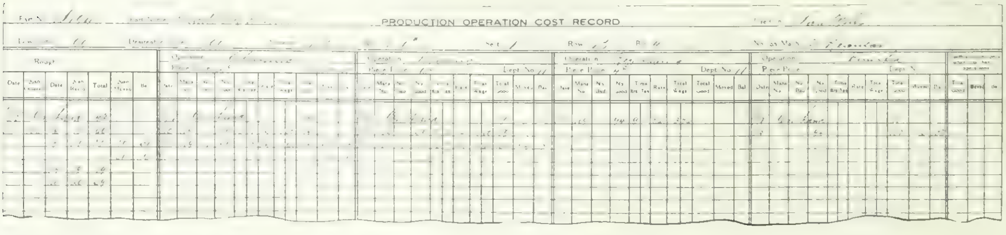
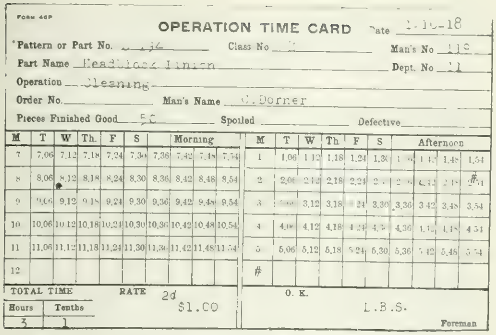

PRODUCTION OPERATION COST RECORD

FIG. 2. COST CARD FOR PRODUCTION DEPARTMENT SHOWING CONDITION OF STOCK



FORM 46P

OPERATION TIME CARD Date 1-10-18

Pattern or Part No. [illegible] Class No [illegible] Man's No 119

Part Name Headblock Pinion Dept. No 11

Operation Cleaning

Order No. Man's Name C. Dorner

Pieces Finished Good 50 Spoiled Defective

M	T	W	Th.	F	S	Morning			
7	7.06	7.12	7.18	7.24	7.30	7.36	7.42	7.48	7.54
8	8.06	8.12	8.18	8.24	8.30	8.36	8.42	8.48	8.54
9	9.06	9.12	9.18	9.24	9.30	9.36	9.42	9.48	9.54
10	10.06	10.12	10.18	10.24	10.30	10.36	10.42	10.48	10.54
11	11.06	11.12	11.18	11.24	11.30	11.36	11.42	11.48	11.54
12									

M	T	W	Th	F	S	Afternoon			
1	1.06	1.12	1.18	1.24	1.30	1.36	1.42	1.48	1.54
2	2.06	2.12	2.18	2.24	2.30	2.36	2.42	2.48	# 2.54
3	[illegible]	3.12	3.18	3.24	3.30	3.36	3.42	3.48	3.54
4	4.06	4.12	4.18	4.24	4.30	4.36	4.42	4.48	4.54
5	5.06	5.12	5.18	5.24	5.30	5.36	5.42	5.48	5.54
#									

TOTAL TIME

Hours	Tenths
3	1

RATE 2d $1.00

O. K. L.B.S. Foreman

FIG. 3. TIME CARD USED FOR BOTH DAY AND PIECE WORK

production department and increase it's value. To simplify the explanation of the working of these cards, this illustration indicates that the first entry was made on January 1, 1918. By referring to the card we find that on this date there were 42 pieces in the rough state, 14 pieces on which the first operation had been finished, 9 pieces that had passed through the second operation, and 11 pieces that were completely finished and were ready to be incorporated in the machines along with the various other parts.

Before proceeding further let us consider Figure 3, This operation time card (4 x 6 inches) is printed in two colors, white for daywork, green for piecework. For every operation performed one of these slips is made out and O.K'd. by the assistant foreman in the department. The operators are paid from the information contained on these slips. This same information provides the means whereby the production-operation cost cards are kept up-to-date. The time cards are received in the office early each morning. The necessary calculations are made, the cards pass through the time department and are given to the man in charge of the production records. When the cost department has been instructed to keep the cost of a certain order, the information is passed along to the factory departments interested and the corresponding office order number will appear on each time card as received. This method is usually followed only in the case of special orders. With the regular line, the cost man can secure the needed data from the production-operation cost record card. It will thus be seen that we have avoided duplication of work as the three departments, time, cost and production, receive the information they require from the single record, namely, the time card. For the time department the card is all sufficient. For the cost and production departments the same information is sufficient, but it is accumulated on the larger card to provide a definite accurate record from day to day, week to week and month to month.

GOODS RECEIVED

DATE

FIG. 4 [illegible]

THE PRODUCTION-OPERATION COST RECORD CARD

The inventory taken and recorded on the card on January 1, indicated that the total number of pieces of S194, headblock pinion for sawmills, was 76, (42 plus 14 plus 9 plus 11). At the top of the card will be noted the "Low Limit." These low limits are not arbitrary but simply serve as a guide for the production man. He can allow the stock to run below the figure or amount in the off season or can keep considerably above it in a brisk season. The responsibility is his to see that the supply is adequate to the demand and the low limits serve as a check or warning. All of the low limits and desirable order quantities were fixed only after consultation between the production man and the foremen of the different departments concerned. The foreman in the foundry does not care to change the patterns any oftener than absolutely necessary. The foreman in the machine shop does not want to be constantly changing the set up of the machines. And against these opinions is the need of the production man to keep many thousands of parts coming through in well balanced proportions. In the course of a year a great many entirely different parts must pass over the same machines and if a machine is tied up too long with the production of one part, some other parts will not be ready when needed. On the other hand too much switching around will curtail production.

As the selling season for sawmills is during winter months, the production man, noting that the total of the S194 pinions was only slightly above the low limit amount, entered an order in the foundry (see Figure 1) for 100 pieces of the S194. On January 8, eighteen pieces were received in the machine shop. Figure 4 shows the method of reporting parts received to the production department. These reports are made out in each department in the factory and cover all parts received from another department.

On January 9 twenty-one more pieces of S194 were received from the foundry. The card record shows that the total number of pieces on hand in the rough was 81. On January 10 the machine-shop foreman was instructed to start finishing these castings. Operator No. 119 cleaned out the sand and rough spots between the teeth on the pinion, finishing 50 on the tenth in 3.1 hours and 30 more pieces on the eleventh. Figure 3 shows this operator's report for the 50 pinions cleaned on the tenth. When this report was received in the office, 50 pieces were deducted from the total of 81 pieces in the "Rough" column, leaving a balance of 31 pieces in this column. Thes 31 pieces were "moved" into the second column on the morning of the twelfth as a result of the work done by operator No. 119 on the eleventh. The entry is given the date which appears on the time card. It will be noted, however, that the operator is given credit for only 30 pieces, from which it would appear that one of the castings was defective and the defect was discovered before any work was performed.

On the twelfth, operator No. 162 was started on boring these castings. Fifty pieces were bored on the twelfth and 43 pieces on the fourteenth, giving a total of 102 pieces. This total includes the 9 pieces that were reported in the inventory. We note here that one casting proved to be no good. This defect did not appear until the operator was partly through the operation of boring and it appears that he was paid for 44 castings. If he had spoilt the part he would not have been paid for his work on this casting.

On the fifteenth, operator No. 109 keywayed 94 of these castings and the balance in the column preceding was reduced to 8 pieces. When the last operation is finished the total number of pieces for this column is not recorded in the column but is carried forward to the "Finished" column as 105 pieces. This includes the 11 pieces that were reported in the inventory as being finished. Two pieces were deducted from this final column total, these were probably sent out on a customer's order for repairs, as three or more pieces would have been deducted if a complete sawmill had been shipped. At the top the number of pieces given as being the regular quantity required for a mill is 3. The word "Regular" has been inserted to warn the clerk who enters the record that more or less than three pieces may have been shipped. The customer's order (rewritten on the regular office form) will state the number of headblocks that were furnished with the sawmill. The clerk checks his shipping record from a copy of this order.

Referring back to the "Rough" column we note that on the fourteenth, 19 more pieces were received from the foundry and also 20 pieces on the fifteenth. The card record on the fifteenth would show the following pieces of S194 on hand: Rough, 39 pieces; cleaned, none; bored, 8 pieces; keywayed or finished, 103 pieces.

To arrive at the total quantity it is only necessary to add these separate figures together and find that there are 150 pieces in all in the factory. Not only do we know how many pieces there are but we also know the status of each piece. If a rush order comes in for an unusual number of sawmills, engines, threshing machines, or any other factory product, the production man needs only a few minutes to have an intelligent, comprehensive grasp on the situation and plan his campaign without delay. Allowance is made for repair orders. The man in charge of the repair department furnishes the needed information from his records. Practically all repair parts are kept in a separate stockroom and once the parts enter this room, they are considered, so far as the production man is concerned, as being sold and hence not available for complete machines. After a part is machined and delivered to the repair stockroom, it is deducted from the balance shown in the "Finished" column. When the yearly inventory is taken and the records checked with the actual count, minor discrepancies are adjusted. So far the errors have been of relatively small importance. As a great many thousand pieces are recorded each year, some of which require eight or more machine operations, and the mistakes have been few in number, the results have been gratifying. Figure 4 shows the goods received sheet which is used in reporting to the production department all castings received from the foundry.

As the production-operation cost card is printed and ruled on both sides, eight operations can be recorded on each card. Where more than eight operations are needed to finish the part, another card can be used, simply marking the cards (1), (2), etc. At the extreme right hand side of the card there are duplicate columns, headed "Total Good," "Moved," "Balance." As the quantities checked out (used or sold) are generally much smaller than either the quantities received from the foundry or passing over the machines, additional checking space is required. While, in order to describe this production system, a gray-iron casting has been used as an illustration, it should be noted that all parts are carried along by means of the same record, whether steel or malleable casting, brass casting, bar-steel part, cold-rolled steel part, forging or any other.

Efficiency—Stop! Look! Listen!

By William H. Smyth

Consulting Engineer

STOP!

A MODERN *burglar* is an efficient mechanic; skilfully *marked cards* are efficient means for effecting the separation of a fool from his money; *sabotage* is an efficient method of reducing output; and there exists no more efficient organized human instrumentality than a modern "civilized" *army*.

Skill, ingenuity, pride of workmanship, economy of effort, and ambition to excel, are just as necessary to success in these directions as in the building of safes, the education of fools, the increasing of output, or in the organization and conduct of productive industry.

How futile then, to talk about *efficiency* as though it were something inherently and obviously desirable.

Yet this is the attitude of the "efficiency expert"; and indeed of the writers (almost without exception) who boost that modern craze—The ART OF EFFICIENCY.

The "art of efficiency": reducing outlay, increasing output, accelerating speed—economize! accomplish!!—rush!!!

In the name of human worth! of reason! of common horse-sense! let us pause a moment to consider:

Just WHAT *are* we driving at, with such nervous efficiency?

To WHERE *are* we headed in so mad a rush?

For, indeed, it may perchance be that thoughtlessly WE too, are wasting our hardly earned skill on respectable *burglary*, on conventionalized *exploitation*, on irrational *sabotage* of real vital wealth—our men, our women, our children; or, in ruthless *warfare* on all that makes for true progress—real civilization.

What ARE we driving at?

But, where may we hope to find answer to this seemingly simple question?

Look over the files of INDUSTRIAL MANAGEMENT.

Search the myriad volumes of the *Congressional Record.*

Examine the hodge-podge curriculum of our schools and our universities.

Investigate diligently all these proper sources of information on coördination of aim—unification of purpose—and you will search in vain; the query will remain unanswered.

But, obviously, we must agree upon our *purpose* before we can intelligently direct our energy efficiently to its accomplishment; or before we can hope to know whether our tentative efforts tend in that direction—are in reality efficient.

LOOK!

We are piling up "wealth." Yes, heaping it up in billions of "dollars"; notwithstanding the supposed "wastage of War."

GERMANY piled it up; ENGLAND piled it up; FRANCE piled it up. And yet the Germans became a nation of *slaves,* the English a nation of *paupers,* and the French quit breeding.

And all these nations, even in peace times—*notwithstanding their efficiency in "wealth" accumulation*—loaded future generations with mountainous burdens; "mortgaged" future worker's toil with billion-dollar bonds; and shackled his freedom with unthinkable corporate and national debts.

England, France, Germany, were the three most EFFICIENT nations on Earth—barring the United States.

The present "wealth" of the United States is estimated at about 250 billion dollars.

Our yearly aggregate income is about 60 billions: that is to say: $3,000 per annum for each of the 20 million families, constituting (approximately) the total population—enough for us all to live upon rationally—and raise families, quite respectably.

But our modern "Art of Efficiency" is concerned in other directions than rational living or raising of respectable families. So our efficiency economics divides the "wealth" quite otherwise—TWO-thirds to TWO per cent. of us, and ONE-third to (and scattered rather spottedly over) the other NINETY-EIGHT per cent.

Of our 60 billion revenue, 40 billions go as "income" to the TWO per cent. "wealth"—owners, and 20 billions go as "wages" to the 20 million families.

Thus it has come about that the rather important business of raising respectable families has fallen into disfavor, has become an altogether too hazardous enterprise to be attractive—"it don't pay."

Quite naturally the intelligent among us are retiring from this "extra hazardous occupation" of raising respectable families. Indeed, how could we continue in it, any way? "Efficiency" now demands our WOMEN for "productive work." And even feminine magic has been unable to accomplish the miracle of doing two jobs at one time—efficiently.

And, as between frenzied *production* and sane human *reproduction* there is no hesitation of choice in the mind of the "industrial efficiency expert."

The *wealthy* won't breed; the *intelligent* can't afford to; and the *poor* are too poverty stricken to do other than breed human refuse.

The WAR has given us many urgent warnings, has taught us many valuable lessons; but it has driven in no more scientifically important lesson than that: Nations, any more than individuals, cannot pursue opposite ideals simultaneously; do two important jobs efficiently—at one time. Which is only a variation of the very old saying, "Ye cannot serve God and mammon."

Assyria, Babylon, Phoenicia, Egypt, Greece, Rome, Spain, each in its turn tried the futile experiment—and *failed*. Each had its day, had its choice, had its opportunity for national immortality—chose foolishly and died.

All individual and national experience indicate that "wealth" and right living, as objects to strive for, imply opposite ideals—*men* or things, *personality* or products.

So, if we have chosen to sacrifice to "Wealth" (and debt), it is our privilege; our inestimable privilege—freedom of choice—to do well or ill. But, *freedom* inherently implies responsibility; and choice entails *consequences*. So we must "take what is coming to us"—pay the price.

Our history and our heritage have made us born lovers of liberty. Nationally we would rather die violently than be slaves like the Germans. Thus, (having chosen "wealth" as our ideal—the object and direction of our efficiency), the only alternative is that of the liberty loving French people—quit breeding; die slowly and painlessly by "race suicide"; practice birth control with scientific and expert efficiency.

LISTEN!

Not an exhilarating, or even a cheerful prospect . . . . is it?

But, the day is yet ours; ours to choose afresh; yes, and ours is the unshirkable responsibility to exercise our freedom sanely.

We may not hope to escape the penalty of past errors, for Nature, while lavishly generous, is ruthlessly just. Our punishment will be heavy for our faults have been grievous. With sturdy racial heritage, with noble traditions, and with unparalleled advantages in natural resources, we have deified the mere material things of life, and held lightly—as of little value—human worth, human character, human personality.

If we do not turn from the deification of things and the glorification of efficient production, to a more sane evaluation of *men* and things; *national ideals* and material wealth;*personality* and products; ruthless Nature will sweep us into the scrap-heap of her abortive national experiments, with the same impersonal unconcern as, in the past, she has dumped other great nations. Just as we scrap an unprofitable machine.

The day is yet ours!

But our time of probation is perilously short. If by tomorrow we had won the war, with our victory would end our day of grace.

Democracy does not mean efficient production, nor even equitable distribution of the products; and still more certainly, heaping up "wealth" in unwieldy hoards and concentrating money power into the control of a few irresponsibles does not tend in the direction of democratic efficiency; nor does shackling future generations with everlasting mortgages and burdening future industry with crushing loads of inextinguishable debt, constitute efficient methods for realizing its aims.

The sancity of personality, freedom of opportunity with personally responsible individual liberty of action, are the ideals of Democracy. Men and women are not born into a democracy to be cogs in an industrial machine for the efficient production and accumulation of "wealth." In a democracy, surplus "wealth" is not to furnish luxury for idlers, but to permit leisure for workers; also for the conservation of mothers; and generally to facilitate and make human liberty effective.

A world in arms for this noble ideal—and the realized intelligence of our great nation rising no higher than the efficient production of material "wealth"!

How glorious! but how futile—a world made safe for democracy!—and no real industrial democracy extant to realize therein its wondrous potentialities in social sanity. How inspiring in thought—how crazily tragic in sordid actuality.

A world in arms, and POSSESSION of "wealth" our standard measure of WORTH.

A WORLD IN ARMS!

Truly! it is high time to ask, with anxious and profound seriousness:

What do we really mean by Efficiency?

What is the goal of the Art of Efficiency?

Truly! the time has come to search our souls, humbly and contritely, for answer to the questions:

Just what are we all driving at with such nervous efficiency?

To where are we headed in so mad a rush?

Secrecy Versus Coöperation

By Robert Mawson

With the Quigley Furnace Specialties Company, Inc.

TWO decades, or even a shorter time ago, a prominent feature in the machinery building industry was trade secrecy.

I can well remember spending days in a shop compiling tables of such factors as the pressures required to force wrist pins into steam engine cranks, and the other necessary dimensions in order to produce these forced fits, that is, the amount of allowance to leave the pin oversized to build up the desired pressure.

I also well recall the small country shop where I started work as a machinist. I began on work that to me was wonderful, such as the making of parts to go into a massive steam engine. The reason why I took the building of a steam engine as the height of my ambition, was the fact that my father was connected with that particular branch of engineering.

The Secret of Bell Mixture

In this same country shop, however, the principal line of manufacture was the casting and finishing of bells for chimes. Many of the operations, such as molding, turning and assembling, were carried on openly. Quite often the country people came into the shop and foundry to watch the work. But there was one operation which was a "secret of secrets"—the mixing of the various metals, copper and tin and whatever else was used.

After the fire had been lighted in the melting furnace the owner of the shop would go into his office and carefully lock the door. There, in secret, he would weigh out the metals and come out with the copper in his hands, the tin stowed away in one pocket, and the other ingredients in another. He would walk sedately and reservedly down the shop and deposit the metals in the crucible with his own hands, taking the greatest care to make sure that none of us boys would have a chance even to guess at the weights or the proportions.

This old country shop had been founded by the father of the man who ran it when I was a boy. Perhaps the founder had made the son swear to keep the secret of the bell mixture and never to reveal the necessary proportions of metals that would give a sweet-toned chiming bell. I might add here by way of philosophy that this shop started small and always kept small. Perhaps a different story might be written if the owner had not tried to carry everything worth while under his own hat.

Supposed Secrets Often Merely Standard Practice

Not long ago a rather amusing incident happened during an afternoon when I was visiting two or three shops. In the first one that I went into, the superintendent took me around and showed me a variety of machining methods and shop tools. As we were about to pass from the shop into the office he took me into a corner of one of his departments, after making me swear secrecy, saying by way of explanation "my competitior Mr. Blank would give a thousand dollars to know how I do this particular job." He furthermore told me that he had designed the tool that he was to show me himself. He then revealed the device and I saw a tool set up for crowning stepped cone pulleys. I knew at once that this method and the tools were by no means new and was all the more ready to give the desired oath of secrecy. After a man has visited a large number of shops, joining a secret organization in regard to some particular device is perfectly easy.

A little later I left this shop and started back to the railroad station. As I walked along I happened to pass Mr. Blank's shop and stopped in and asked the superintendent to take me through. As we were about to leave the machining departments he stopped as if remembering something and said, "I have one particular tool that you might like to see but I want to have you promise that you will not say anything about it to Mr. Sharp." (Mr. Sharp was the owner of the shop from which I had just come.) He added further that he did not want to have Mr. Sharp know about this for the world, as he was very proud of the device, it saved him a good deal of time and money, and he had designed it himself. As I had already had practice that very afternoon in swearing secrecy and so was in a good promising mood, I gave the necessary promise. He then showed me a tool set up for crowning stepped pulleys, almost identically like the one I had seen an hour before in Mr. Sharp's shop. After I had looked it over and expressed my appreciation of the quality of work it was doing, I thanked the secretive superintendent for his kindness, and sauntered down to the station smiling to myself as I thought of these two neighboring firms working along in blissful ignorance of each other's shop conditions, and each thinking that he had something new and original not possessed by the other. Yet, as a matter of fact, each had a tool set up of which he was very proud that was neither new, original, nor exclusive.

There Must Be No Secrets in Munition Manufacture

In general, there is no excuse for trade secrets. As one prominent manufacturer put it, "trade secrets are punk." And above all there is one industry in which not a single secret of any kind is warranted. I refer to the manufacture of munitions of war.

What are we making war supplies for? It is to bring a speedy conclusion of the present war and obtain a lasting peace, it is not to build up a manufacturing business that is to be carried on indefinitely. The only possible excuse for business secrets is to protect something that may help to perpetuate the life of a business. And heaven knows that we want to get through with our present industry of producing war material just as soon as possible.

Here is a case in point. Not long ago I remember going to the shop of a firm that was making cartridge cases and was told that they had spent three months of valuable time in experimenting before they were able to obtain the correct draws, design the punch press tools and begin manufacturing. Not many miles away was another firm making this same case and doing it successfully. From every possible viewpoint this second shop should have helped the first. England has shown us unmistakably how to work out a system of close coöperation. It has come through the placing of shops engaged on war work under government control.

Such a step in this country need not take away the individuality of our manufacturing enterprises. Just imagine for a moment that a shop is starting on a contract to manufacture shells. If another factory is engaged in this same or similar work and has had a successful record, it should be possible for the new comer in this line of production to ask assistance and if need be receive personal supervision from the organization of the other. If need be, engineers or designers or shop men should be loaned for a while to assist in establishing the best possible manufacturing methods in the shop that has begun the new contract. Men who are capable of performing this kind of expert service should be known to a government board and their qualifications should be made use of to the very highest degree in furthering the success of the production of war materials.

In other words, each shop manufacturing munitions should not be considered as a separate unit, but rather as a part of a harmoniously working whole. This can only be obtained by a system of coöperation between the Government and the manufacturing firm.

Getting Together

By William Judson Kibby

THIS old war has brought to industry one great lesson, a lesson we will never forget, and we are going to profit by it more and more as the years go by.

That lesson is to be found in the "get together" spirit which the Allies have shown. They have buried all selfish aims for one big goal, to win the war, and well do we know how much more effective we might have fought had we been prepared. We sat by and let Germany prepare for 40 years and made small effort to protect what we had accomplished.

We have a distinct advantage which should accrue to us at once and nothing should interfere with our creating a closer bond of understanding between the worker in the factory and the executive heads. To do this, however, it is necessary to have a well defined policy; there is but one correct way to do it and that is through the proper education of foremen. The foreman must secure the executive viewpoint, and he can only obtain this by gathering him in meetings organized upon grounds of equal reasoning and upon a plane of common understanding.

With the foremen must be included department heads, overseers, etc.—all the men in pivotal positions.

To bring these men together on the ground of discussing difficulties in the general routine of every day work, means that the gathering is generally a place in which to vent personal grievances. As a basis or ground of "getting together" this method has usually proven a costly one and has been abandoned. Men should be brought together first and talks given to them on their own plane by men who know them as a class, and are capable of spreading the right spirit, not alone among the foremen but most of all among those at the top.

Most of the men who fill foremen's positions (except in certain specialized or technical lines) have had a meager education, and even though they had a splendid schooling, they as a class have seldom gotten the executive viewpoint except where the institution has fully realized the force of the situation. We fully realize this fact, but in the main this holds true that they are inclined to think along exceedingly limited lines and generally with the great mass of which they form a part.

VALUE OF OUTSIDE HELP

As a rule outside help can bring to these men lessons based upon principle much more effectively than one employed by the institution, and yet great care should be exercised in bringing into an organization outside specialists for often they have done more harm than good. As a class foremen are apt to suspect an outsider as being wholly on the side of the man who pays the bill. The specialist should not be allowed to come in to deal with the foremen upon any but human relations. Details of routine should be handled by men regularly employed and at separate meetings and not at the general meeting of foremen. Such meetings should deal with principles of organization, coöperation, supervision, errors, etc., and above all through these meetings strive to generate a spirit of fair play which becomes automatic from the top down and no such meetings should be attempted without some of the important executives being present, for if the spirit of fair play does not find its way from those in authority it will not become a fixed policy at the bottom. Policies as a rule, are never fixed at the bottom.

The man at the work bench and machine is going to have a lot to say about the management of industry in the future where the policy is unfair, and where the executive has not thought enough of his men to see to it that a plan was evolved whereby he could meet and know his people and they him.

A HOPEFUL SIGN

One of the happiest and most hopeful signs of the times is to see the ever increasing number of industries both large and small gathering together their pivotal men and creating a closer bond of common interest.

It is estimated that over 65 per cent. of the men in foremen's positions are members of some fraternal society. This proves that they do get together on one common ground and yet we let a latent power go by unused which might become of great usefulness.

Throughout the length and breadth of our land there has sprung up in the last few years noon-day meetings of Chambers of Commerce, Rotary, Kewanis, Engineering and many other clubs bringing to the local men speakers dealing with big problems of industry and nation. So much so, that it is in the air, and yet industry has been woefully slow to gather this impetus for educating her most important unit "the forepeople."

The labor condition is acute and bids fair to become even more so, but the industry that has been getting its men together will have far less worry than the one that argues that, "Well the soup house will bring them galloping back after a while when the war has been settled." Many who share this opinion will share it later on to their sorrow, for there will be no soup houses and no clamor for work, no panics save the panic of the employer who has neglected properly to lay the foundation for the "great readjustment period" which is going to bring with it many vexing problems.

Every indication points to the drastic need of immediate action in regard to the unity of purpose between capital and labor, for their interests are one, but have been kept separate far too long because the executive head has not fully realized the high importance of a correct relation between them. The labor policy has been dictated only too often by unfriendly hands, while it might have been a matter wholly between the employer and his men. Whatever may be our own views regarding capital's attitude toward labor, the facts are that the condition of mind on the part of labor is largely due to sheer neglect on the part of the employing class. So much so, that it is going to be a real task to readjust their differences and calls for the most careful analysis and a method to be employed in order that both may find a happy ground of adjustment and settlement.

NEED OF CORRECTIVE METHODS

Men will not be driven and capital will not be driven. Facts are, that men have always despised to be driven but the executive, broadly speaking, has seldom realized the smouldering fire of hatred secretly growing within the breast of his men, even among those inclined to be loyal. Too many such men have gone over head long into the opposite camp, largely because of the lack of a broader viewpoint on the part of both.

Labor is firmly entrenched and will be increasingly so as the war goes on and, therefore, corrective methods should be applied to this problem at once, and no sincere effort left untouched in creating a vehicle upon which to teach the men governing the rank and file at work bench and machine.

May we state again that the difficulties encountered by the writer (covering hundreds of plants) is seldom found among the foremen but almost always at or near the top. This is not said to offend, but to state the truth plainly enough to awaken greater effort or at least a kindlier interest in the solution which beyond a doubt hinges to a large extent upon the training of foremen.

Criticism and Individual Efficiency

By Lieutenant R. T. Strong, N. N. V.

NEARLY a year and a half of our participation in the war has passed. We have learned by this time that the job calls for every effort of every man and woman in the country, that every industrial and household manager, stenographer and laborer, soldier and sailor, is a factor in the fight. In general we may say that each of these is by this time striving to do some share of the work. That much, at least, the war has done toward solidifying the country.

We cannot say, however, that everyone is striving along the same lines. Much of this individual effort is misdirected, much energy is expended in working at cross purposes, in building up and hauling down but accomplishing nothing. We have not yet attained to any degree of coördination in our thought and purpose, we are still too easily swayed from side to side by gossip and unsupported statement. Clear and honest thinking, the sorting of the occasional fact from the ever recurring rumors, is our great necessity. Ford Maddox Hueffer has covered this with scientific accuracy in the first two chapters of his "Between St. Dennis and St. George." Unfortunately such a book is read by comparatively few, and those usually from among the number to whom its arguments do not particularly apply.

To follow his argument, a certain "correctness of attitude" is essential. If we are to work well we must first acquire the correct point of view and we must then think straight. There are in general three points of view encountered as regards the war.

First. The optimistic view. This emphasizes the big things that have been done, the splendid spirit and bravery of the men at the front, and the loyalty any courage of the countries engaged.

Second. The pessimistic view. This sees only the mistakes, the bitterness and the horrors of the strife.

Third. The pacifist view. There are still a few who even yet believe that we are involved in a war which does not concern us. This viewpoint need not be discussed here. The time has passed when it can properly be held by any true American.

The True Viewpoint

The true viewpoint, of course, lies midway between the first and the second. Let us sort out from the mass of rumor and gossip that surrounds us that which we know to be true and that which is direct evidence from reliable sources, and base our judgments on these. Then let us recognize our successes and hold fast to them, and let us admit our shortcomings and correct them. There is much to be proud of. The generous support given to the Liberty bonds, the general assent to such revolutionary measures as conscription, news censorship, control of shipping and railways, the quiet and business-like way in which our navy took up its patrol of the sea and in which our men are sent safely and steadily into France are big things to the credit of the nation. But patting oneself on the back for things well done does not tend toward improvement. There are also many shortcomings, for there have been failures of men and material, there have been many plans ill-conceived and poorly executed. The question is, "What can be done to prevent these failures in the coming year?"

Ask a hundred men on the street this question, and you will get a hundred different answers. Ninety-five per cent. of these answers will either include only one small phase of the job or they will be so befogged with prejudice as to be valueless. The reason for this is that very few persons approach such a question with the scientific attitude. They have not what Hueffer calls the "historian's faculty" of sorting out that which is first-hand evidence from the great mass of newspaper reports and local gossip. The scientific manager in making a decision gathers, first, all the available data on the subject, then throws out all which is not fully authenticated or which is inapplicable, and makes his decision after careful study of that which remains. How many men use the same method in making decisions on the political policies and methods of the day?

Difficult to Get Proper Perspective

There are too many judgments coming from the midst of the work, so that details are distorted to many times their relative size, or from viewpoints so far detached that controlling factors, principles, or conditions are entirely overlooked. It is often difficult to obtain the proper perspective, but it is absolutely essential to an intelligent consideration of any question. The man submerged in the detail of war, striving for results against the handicap of untrained men, shortage of equipment, and general lack of preparation, must get away from his job and consider the nation-wide problems that are being handled. The man not directly occupied in the business of war must be in touch with what is going on if he is to be competent to judge efficiencies.

It is easy to sit and deplore the mistakes that have been made, it is easy to howl at those in the lead, and at their methods. Destructive criticism is always easy and, unfortunately, always in evidence. You may hear it on the streets, in private homes and in the wardrooms of battleships. To tell these critics that by their criticism they are fighting the battle for Germany evokes indignant denials, yet it is the simple truth. The only justification for criticism is in its use as a guide to future operations, and to the correction of present faults. We must build up, tearing down only where necessary to erect a stronger structure.

Also we must beware of the man who cries, "Destructive criticism," whenever the light of investigation and suggestion is turned in his direction. Such an attitude is in itself a confession of weakness. It will kill all improvement, even as destructive criticism tears down that which has already been attained.

Importance of Personal Efficiency

The second purpose of this article is to emphasize the importance of personal efficiency. The efficiency or inefficiency of a democracy depends on the efficiency or inefficiency of the individual. Autocracy may reach the more brilliant heights of 100 per cent. pure efficiency, yet the democracy builds the more substantial and lasting structure. That is the principle for which the country is fighting. It is the underlying principle of our national life, if it falls the nation falls with it.

The test of this principle is being made in the trenches, on the sea, and in the factories and homes of the world. Every individual, by his own work, is either strengthening it or tearing it down. Insofar as he is efficient in his own work he is supporting the democracy; insofar as he relies upon the system to carry him through he is aiding the autocratic system. We must do three things: First, do our own work as it should be done; second, consider honestly and without prejudice the suggestions of others; third, make our own suggestions for improvements and the elimination of faults. When peace comes, and the eternal rightness of the principles of democracy is proven, each individual must answer to his own conscience and to the spirits of those who gave their lives, "Did I play the game; or did I merely block the players by my own selfish criticism and inefficiency?"

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Computing Labor Turnover

A Questionnaire

AT the request of Mr. Daniel Bloomfield, and with his assistance, INDUSTIAL MANAGEMENT prepared and sent to a number of employment managers in prominent industrial plants a questionnaire aimed to bring out helpful information in regard to labor turnover. The questions are as follows:

1. How do you define "labor turnover"?
2. How do you compute labor turnover
   - (a) when trying to maintain a normal force?
   - (b) when increasing your force?
   - (c) when there is a loss of workers bringing the force below normal?
3. When computing the turnover for a particular month how much stress do you lay
   - (a) on the daily average of persons at work?
   - (b) on the monthly average?
   - (c) How do you obtain your daily average and your monthly average?
4. Explain any other method or methods of computing turnover known to you, as the cumulative average.
5. State the formula best suited, in your opinion, to give an accurate diagnosis of the labor turnover condition.

A most cordial reception was given to this request and a number of helpful replies received. From them 16 have been selected for publication below in symposium form. There has also been included the report of the special committee of the National Employment Managtrs' Conference, held at Rochester in May, appointed to draw up a definition of labor turnover and present a formula for its computation. This report when presented to the Conference as a whole was modified and the standard definition as adopted, together with its method of computation, are also included.

It is hoped that the bringing together of these various points of view and methods will be of service in aiding our understanding of a term of large significance in employment affairs.—THE EDITORS.]

By Daniel Bloomfield

Partner, Bloomfield and Bloomfield, Employment Management Service

1. *Definition.* Labor turnover is the condition in industry represented by the engagement, loss and replacement of workers. It represents the leakage or waste of man power and is a fair index of the efficiency of management methods and conditions of employment.

2. *Method of Computation.*

Let $T =$ turnover
$A =$ average number employed for period computed
$L =$ loss
$M =$ transfers from department to department
$U =$ unavoidable losses

Then $$\frac{L-(M+N)}{A}=T \qquad (1)$$

When increasing the force, subtract the increase from the number hired during the period. This will give the amount of loss or value of L. Then use formula (1).

When decreasing the force, add the number represented by the decrease to the number hired during the period to obtain the number leaving or value of L. Then use formula (1).

3. In computing the turnover for a particular month the greatest stress should be laid on the *daily* average. The most accurate method of obtaining this is to add the figures on the payroll for each day and divide the result by the number of working days. Where this is found to be a difficult matter the figures on the payroll at the end of each week should be added up and the result divided by 4.

4. Some employment managers do not consider unavoidable losses (death, illness, old age, etc.) as a part of their turnover and so deduct that from the number representing the loss. Their formula is the same as No. 1:

$$\frac{L-(M+N)}{A}=T$$

Still others use the following formula: They first obtain a monthly average by adding the number on the payroll at the beginning of the month and the number at the end of the month and divided the result by 2. This average is then, divided into the number replaced on the payroll.

5. The best formula, in my opinion, designed to diagnose the labor turnover situation of a plant accurately, is the following:

$$\frac{L-(M+U)}{A}=T \qquad (2)$$

This formula allows for the elimination of the unavoidable elements from the final figures. Transfers are also deducted because they really do not represent a true loss of man power. Of course, one can go into fine hair splitting about transfers and separate promotions and shifting from one department to another but such attempts are only of academic value. What the employer desires to know is, "What is the preventable turnover?" Knowing this he can plan to remedy the condition.

The formula to be used in obtaining the percentage of turnover of a single department would be:

$$\frac{L-U}{A}=T \qquad (3)$$

A transfer from one department to another is really an exit from the former and an entrance to the latter, hence transfers here should not be deducted.

* * * *

By R. P. Dolan

Superintendent of Employment Service, Nashua Gummed & Coated Paper Co.

1. Labor turnover is the number of employees made necessary to "hire or fire" in order to maintain a working force.

2. (a) When trying to maintain a normal working force we consider as turnover the number entering our employ.

(b) When increasing our force we consider as turnover the number leaving our employ.

(c) When there is a loss of workers bringing the working force below normal (what might generally be known as a lay-off) we consider as turnover the number entering our employ.

3. (a and b) We lay no particular stress on the daily and monthly average of persons at work outside of the fact that we compute our turnover from the monthly average.

(c) We get our average number of people employed by keeping a perpetual labor inventory from which we know at any time the number employed departmentally. Our daily average is arrived at by adding the number of employees for the month and dividing by number of working days in the month. This will also represent our monthly average.

4. We know of no other logical way for computing turnover.

5. The best formula suited to give an accurate diagnosis of the labor turnover condition in my opinion, is the turnover sheet adopted by the Employment Managers' Association of Boston.

By D. R. Kennedy

Employment Supervisor, American International Shipbuilding Corporation

1. The number of men necessary to hire to maintain the average working force.

Other definitions quoted:

A. Proportion between the total number of persons hired during a certain period and the average number employed for that period.

B. Change in personnel brought about by hiring and termination of employment.

C. Number of men you hire to take the place of the number dismissed from the payroll.

D. Number of men you hire less increase in the number on the payroll.

2. The average working force, or what is often styled as the mean of the number of employees on the payroll, for the period should be taken as a basis for computing labor turnover. To obtain this mean take the number on the roll at the beginning of the period, plus the number on the roll at the end of the period and divide the sum by two (2). Your result is then divided into the number of persons replaced during the period to give the percentage of turnover for that period.

However, this method of obtaining the mean, or average, is not sufficiently accurate to warrant proper results, and I would suggest that the number on the payroll for each day be taken, and then divide the total by the number of days to compute the average; with a view to secure a more nearly accurate working basis; then divide your mean or average working force into the number of men replaced (or the number necessary to hire to maintain this average force) to get the percentage of turnover.

Let T = labor turnover.
L = number of men leaving service (number of men necessary to hire to maintain the average working force)
U = unavoidable losses
A = average working force

Then $$\frac{L \quad U}{A} = T = \text{labor turnover} \qquad (4)$$

Whenever there is a general decrease in the number of employees on the payroll during the period, the relation of the number of new employees (number hired to maintain the average) to the average working force should be taken.

Example. Let us assume that the average working force for the period was 841, that 233 men were hired and 304 men left during that period, the number of men necessary to hire to maintain the average force would be 233 men. By dividing 841, the mean or average working force into 233, the number replaced, gives us a turnover of 27.7 per cent.; the amount by which the number of quitters exceeds the number of new employees accounts for the reduction.

However, where there is an increase in the force, the relation of the number of quitters (or the number hired less the increase in force) to the average working force should be taken.

Example. Let us assume in this case that the average working force for the period was 586 men; that 242 men were hired and 208 were dismissed from the payroll during the period. In this case the number hired to maintain the average force would be 208. Then, by dividing 586 into 208, you will get 35.5 per cent. labor turnover.

The amount by which the number of new employees exceeds the number of quitters accounts for the increase of 34 employees.

In view of the fact that since the average working force for the period is taken as the basis for computing the turnover, it is advisable, if not imperative, that a daily record of the working force be kept with a view to obtain a more accurate average working force for that period.

ANOTHER METHOD OF COMPUTING LABOR TURNOVER

Another method of computing labor turnover somewhat similar to the one just mentioned is carried out by a number of corporations. It is as follows:

The basis for figuring turnover percentage in this case is by using the mean of the number of employees on the payroll. To obtain this mean they add the number on the payroll at the beginning of the month to the number on the payroll at the end of the month and then divide by two (2). This mean is then divided into the number of persons replaced on the payroll during the month to get the percentage of turnover for that period.

Example. Assume that on the first day of the month there were 1000 men on the payroll and 1000 men on the last day of the month, and that 500 men were hired during that period. The labor turnover in this instance would be 50 per cent. However, if there had been 1500 men on the payroll on the last day of the month (500 men hired) there would be no turnover in view of the fact that no men were replaced.

When increasing the force let us take another illustration: Where there are 1000 men on the payroll on the first day of the month and 1300 men on the payroll on the last day of the month, and 500 hired during that period: In order to calculate properly the percentage of turnover divide 200 (the number of men replaced) by 1150 (the average working force for the month) which gives 17.4 per cent.

When there is a loss of workers bringing the force below normal, let us assume that there were 1000 men on the payroll on the first of the month and 900 at the end of the month, and that there were hired 300 men. This will give a labor turnover of 31.5 per cent. You will note that 400 men were lost to the payroll but only 300 were replaced.

To secure an accurate diagnosis of labor turnover conditions, it is advisable that the classification of workers be utilized to the greatest extent. For instance: In case of a shipyard, it can be divided roughly into three classifications:

A. Construction: Monthly payroll, weekly payroll, skilled and unskilled.

B. Shipbuilding: Monthlv payroll, weekly payroll, skilled and unskilled.

C. Overhead: Monthly payroll, weekly payroll, skilled and unskilled.

Then by keeping accurate statistics relative to these various classifications, you will be in a position to obtain the per cent. of labor turnover.

By H. H. Magowan

Manager, Employment and Service Department, Chester Shipbuilding Company, Ltd.

1. Labor turnover is the relation between the average daily number of employees on the payroll and the total number of exits per month.

2. The turnover should be computed in the same manner under any conditions.

3. (a and b) The turnover is computed on daily average number of persons on payroll in both cases. (c) The daily average is obtained by adding the number of employees on the payroll each day and every working day in the month and dividing this sum by the number of working days in the month. We do not use the monthly average of persons at work.

4. One method known to the writer is adding the number of employees on the payroll the first day of the month to the number of employees on payroll the last day of the month and dividing this by two and comparing the sum with the number of men terminated for the month. This is thought to be incorrect.

Some employment managers believe that the unavoidable exits such as deaths, draftees, imprisonments, etc., should not be considered in the light of an increase to their turnover. This viewpoint is discredited, however, when one reflects that these terminations mean extra cost to the employment department, especially at the present time when production is of the utmost importance on account of the war.

5. I consider that the best formula to give an accurate diagnosis of the labor turnover condition is as follows:

Let N_1 = number of employeer on payroll the first working day of the month
N_2 = number of employees on payroll the second working day of the month.
N_3 = number of employees on payroll the third working day of the month
Continue to N_{31} should there be 31 working days in a month
B = number of working days in the month.

Then $\dfrac{N_1 + N_2 + N_3 + \dots\dots + N_{31}}{B} =$ the actual daily average number of employees on payroll (5)

Now let L = total number of losses or terminations for the month.
T = turnover.

The formula for turnover is

$$T = \frac{L}{\dfrac{N_1 + N_2 + N_3 + \dots\dots\dots + N_{31}}{B}} \qquad (6)$$

I think this to be the true formula for obtaining the accurate labor turnover for the month.

By E. H. Fish

Employment Director, The Norton Company

The matter below was prepared for the Employment Managers' Association of Boston and covers the questions asked:

Labor turnover is the percentage of employees which it is necessary to replace over a period of one year's time. For example, a shop which maintains steadily 1000 employees throughout the year, but finds it necessary to hire 650 new men, losing an equal number, will have a labor turnover of 65 per cent. provided none of the losses were unavoidable.

Consider a shop which is growing in size; for example, one which at the beginning of the year has 1000 men, but at the end of the year has 1500, the increase having been steady throughout the year so that the average number of employees is 1250. If in order to increase from 1000 to 1500 it was necessary to employ 1000 new men, then only 500 men would have been replaced, the rest having gone to increase the force. In that case the labor turnover would be 500 divided by 1250 or 40 per cent.

If the shop is decreasing in size, that is, if the same shop begins with 1000 men and at the end of the year has only 800, but while losing 200 men hired a total of 100, then it would have replaced only 100 men. The average payroll is 900, so the percentage of labor turnover would be 100 divided by 900, or 11 1/9 per cent.

In each of these examples no account has been taken of the replacement of men who left through no fault of the company as, for example, death. It is also customary to leave out of consideration in figuring labor turnover, women who leave when they are married, as we consider that also beyond the range of our influence. We also leave out of account all transfers from one department to another when we are figuring the labor turnover for the whole shop. In figuring the labor turnover for separate departments, of course, these transfers should be treated exactly as if they were discharges from one department and newly hired in the other.

It is the custom to use for the average number of employees the average of the number on the payroll at the beginning of each month or each week of the year. This is not accurate but it is probably as accurate as is necessary, the labor turnover in any shop being an indication of conditions rather than an exact measure.

When labor turnover is computed from week to week or from month to month it is customary to multiply the number of employees hired and those leaving by 52 or 12 as the case may be, so as to get the same result as if the whole year were taken into account.

It has been the custom to compute labor turnover on the basis of the number of employees on the payroll, although to be more strictly correct it should be figured on the average number working, reduced to a full working week's basis. For example, if the average employee works 50 hours per week when the shop time is 60, then only five-sixths as many men are effectively engaged in work as are shown on the payroll.

The following formula is used for computation of labor turnover:

Let T = labor turnover per year
L = losses, or number of men replaced per year
$M = \frac{1}{2}$ (number of men working at beginning of period + number working at end of the period).

Then
$$T = \frac{L}{M} \qquad (7)$$

The number of men replaced per year should not include those who die or who leave on account of marriage, nor should it take into account transfers between departments unless a departmental turnover is being considered.

EXAMPLES

Week ending February 16, 1918

Hired	29
Transferred in	10
Left on own accord	34
Discharged	5
Laid off (lack of work)	7
Died	1
Transferred out	10

Number on payroll February 9, 2701

Number on payroll February 10, 2683

To find turnover for shop as a whole:

Total leaving less transfers and death, 46

Total hired, 29

Since only 29 men were hired only that number were replaced, therefore, the numerator of our fraction should be 29 times 52. The average number on the payroll is $\frac{2701 + 2683}{2}$

$$\text{or } \frac{29 \times 52}{\frac{2701 + 2683}{2}} = \frac{1508}{2892} = 56 \text{ per cent.}$$

Another example is for the case when the force is increasing.

Week ending February 23, 1918

Hired	63
Transferred in	12
Left of own accord	22
Discharged	4
Laid off	3
Married (female)	2
Transferred out	12

Number on payroll February 16, 2683

Number on payroll February 23, 2715

In this case while 63 were hired, 32 of them were to increase force and only 31 to replace others. Two left for unavoidable reasons, therefore, our fraction is:

$$\frac{(31 - 2)\,52}{\frac{2683 + 2715}{2}} = \frac{1508}{2749} = 54 \text{ per cent.}$$

Departmental turnover is computed as follows:

Week ending February 23, 1918

Hired from Department No. 1	20
Transferred in from other departments	3
	23
Left on own accord	6
Discharged	2
Transferred out of department	2
	10

Number in department February 23, 402

Number in department February 16, 389

In this case 23 came in, 13 to increase force, 10 to replace others, therefore, this is figured.

$$\frac{10 \times 52}{\frac{402 + 389}{2}} = 131 \text{ per cent.}$$

It should be borne in mind that an average of the labor turnover taken monthly or weekly is not a true average, as the turnover when the shop is growing if considered positive would make the turnover when the shop was decreasing in size negative.

* * * *

By Arthur F. Clough

1. There has always been considerable difference of opinion regarding a definition of the phrase "labor turnover," but I should state it as:

Labor turnover is the change in the wage earning and salaried personnel of an organization, brought about by the hiring of other workers to replace those permanently leaving in any fixed period.

It may be expressed in terms of the relative percentage of workers hired to replace those permanently leaving in maintaining an average working force for any fixed period.

In referring to the salaried personnel of an organization, I do not include persons who are paid on a strictly commission basis. To my mind, such employees are, so as to speak, in business for themselves and cannot be figured in computing labor turnover, in the sense that the term is generally used.

It will also be noted that the foregoing definition concerns itself only with *the replacement of those permanently leaving an organization.* It does not take into account, therefore, increases or decreases in force when there is no replacement of workers, or, in other words, no "labor turnover."

2. (a) On an annual basis. I endeavor to set what I have termed an "average working force" for the year, the estimate for this figure being based on the number of essential workers on the payroll January 1, who are needed to keep the plant at normal capacity, irrespective of labor maintainence or turnover. Turnover is then computed monthly by dividing the number of replacements during the month by the number on the payroll the first day of the month. The total of monthly percentages for the year gives the approximate annual turnover percentage.

(b) The "average working force" may be a fluctuating factor throughout the year. Increases above the normal factor are automatically taken care of by monthly computations of turnover, except with respect to the number of replacements involved when increasing the force. Since the turnover computation is always based on the actual number of replacements made during the month, it is desirable to keep a separate account of replacements involved when adding any specified number of new workers to the force. Turnover percentage for the month is then computed from the replacements made when increasing the force, plus the replacements made in maintaining the normal force, which is indicated by the actual number of employees at work on the first day of the month.

(c) When workers are released and not replaced, turnover cannot be figured, and percentages must be based on such employees as are left in the organization. While not as accurate as might be desired, for the sake of uniformity I figure turnover percentages when reducing the force on the basis of those employed on the first day of the month. A partial remedy for the slight inaccuracy thereby involved, might be to shorten the periods for which the turnover is figured and make it weekly or daily. At present, I cannot see sufficient advantage in computing turnover daily to make it worth the clerical labor it would require. Workers released and not replaced are disregarded in computing turnover.

3. (a) Have never computed turnover on the daily average of persons at work.

(b) This has been fairly clearly indicated in previous paragraphs. I have found monthly averages of turnover to be of value in indicating seasonal fluctuations in labor demand throughout an organization, and also in calling attention to periods of labor unrest.

(c) Have obtained monthly averages in two ways. The first, by a series of "Return Reports," sent to the employment department whenever a worker leaves, and the compilation of monthly records from them, averages being made from statistics covering quarterly, semi-annual or annual periods.

As a substitution for the return report system, recourse may be had to timekeepers' and paymasters' records.

5. (a) For computing normal turnover, divide the number of replacements during the month by the number of employees on the payroll the first day of the month. Carry percentage figures to the second decimal point.

(b) For computing turnover when increasing force, add the number of replacements made in increasing the force to the number of replacements made in maintaining the normal force during the month and divide the total replacements thus obtained by the number of employees on the payroll the first day of the month. Carry percentage figures to the second decimal point.

(c) For computing turnover when decreasing force, divide the number of replacements during the month by the number of employees on the payroll the first day of the month. Carry percentage figures to the second decimal point and disregard altogether employees who were released and not replaced.

(d) For computing turnover when force is both increased and decreased, ignore decrease altogether when replacements are not made. To the number of replacements made in maintaining the normal force for the month, add the number of replacements involved in increasing the force and divide the total thus obtained by the number of workers on the payroll on the first day of the month.

This method gives approximate, *not accurate*, turnover figures, but is sufficiently close to be satisfactory to most employment managers. The only way I know of to obtain *accurate* turnover figures is to keep daily records and percentages, a proceeding too cumbersome and costly to appeal to many.

* * * *

By G. E. Jacquet

Employment Manager, The Shawinigan Water and Power Company

1. We consider labor turnover as the ratio of the number of men leaving our employee, divided by the number of men on our pay-roll.

2. We have only recently started the compiling of data to determine turnover, and have not yet made allowance for the varying conditions that should be taken into account.

* * * *

By Mark M. Jones

Supervisor of Personnel, Thomas A. Edison Interests

1. Labor turn-over represents changes in the working force.

2. It is computed by comparing the unavoidable exits to the average working force during the period in question.

3. The stress to be laid upon the daily or monthly average of persons at work depends to a certain extent upon the policy of the enterprise. The daily average or monthly average might be obtained from payrolls or from absentee reports.

4. We are inclined to believe that too much stress can be placed upon reducing the facts in connection with changes in working forces to figures. In other words, we think that it is possible to carry it too far and that oftentimes little, if any, useful purpose is served by reducing labor turnover to a percentage basis. This is a comparative matter, however, and depends upon the particular case.

5. We have not made any special study of the question, as we have deemed it of lesser importance. It has proved sufficient to know the number of changes in our working forces and that these changes were entirely too high, as well as that anything we might do to reduce them would be warranted, and clearly justified.

The practice of formulating such information on a percentage basis might be useful in connection with the comparison of conditions in a number of different enterprises. While we have followed the thought of industries generally in this connection, we have not given it any special study, believing that our efforts should be directed toward the important activities necessary to correct the conditions responsible for the changes. It is a matter of refinement and we have had little opportunity for extensive refinements.

* * * *

By R. O. Kennedy

With Cluett, Peabody & Company, Inc.

We have considered labor turnover to equal the amount of re-employment necessary to maintain a stable working force. For instance, in an organization of 1,000, a dropping of 400 and an employment for replacement of 400, would constitute a 40 per cent. turnover.

We are at a loss how to figure the percentage when increasing a force or when decreasing.

We are inclined to favor the plan of figuring the monthly percentage of turnover by taking the average of the number of employees at the beginning and end of the month as a divisor and the number of new employees as a dividend.

The percentage of turnover for a month will not be anything like that for a year, and the distinction between the monthly and yearly turnover must be noted or confusion will follow.

We have always been expressing our percentage of turnover in a period of a year, considering as the divisor the lower number of employees at the beginning or end of the year. If it had been an increased force it would be the number at the beginning of the year. If it had been a decreased force it would be the number at the end of the year.

* * * *

By B. D. Rodgers

Superintendent, Labor Bureau, Bird & Son

1. Labor turnover is the change of employees brought about by the persons hired and leaving the employ.

2. (a) When maintaining a normal force, we compute our labor turnover by taking the mean of the total number entering and leaving our employ divided by the average number receiving pay for a given period, the answer given in percentage.

(b and c) Since the establishment of our labor bureau in 1913 we have made a very gradual increase in our force, but have never made any allowance for that in figuring our turnover. Should we suddenly increase our force to any considerable extent we believe that the fairest way to figure turnover would be to divide the average number employed by the number dropped. If, on the other hand, our force was diminished, we believe it should be based on the number hired.

3. (a) None.

(b) Our force remains so fixed that our turnover figures are based on the number of employees receiving pay on the last payroll period of each month. We have found by careful attention to lost time and absence from work that the number of persons absent from all causes is less than two per cent.

(c) As stated above, we obtain our monthly average by taking the number of employees actually receiving pay in the period nearest the last of the month.

By Harry W. Kimball

Employment Manager, Arnold Print Works

At the Arnold Print Works the labor turnover is computed on a monthly basis. A distinction is made between plant fluctuation and labor turnover.

Plant fluctuation is increase or decrease from month to month of the total number of employees in the plant. Inasmuch as the Employment Department is not responsible for plant fluctuation, it should be ignored in determining labor turnover.

Labor turnover is the number of employees hired during the month to maintain the working force in the various departments of the plant. In our own employment department I have made the following rules for determining the percentage of labor turnover monthly.

1. If the number of help in the department at the end of the month is greater than at the beginning of the month, to obtain percentage of labor turnover, divide the number of persons leaving by the number in department at the beginning of the month.

2. If the number of help in the department at the end of the month is less than at the beginning of the month, to obtain percentage of labor turnover divide the number of help hired by the number in department at the end of the month.

3. If there has been no change in the number of help, divide the number hired by the total number employed.

4. The percentage of labor turnover for the entire plant is determined as follows: If the number of help at the end of the month is greater than at the beginning of the month, divide total number leaving by number employed at beginning of the month. If the number of help at the end of the month is less than at the beginning of the month, divide total number hired by number employed at the end of the month.

This method of computing labor turnover is not absolutely accurate, because a month is an arbitrary division of time and there might be vacancies on the last day of the month which would be filled on the first day or two of the next month. By our method this would be considered a part of the plant fluctuation and in reality it would be a part of the labor turnover. However, by taking account of the unfilled requisitions on hand at the end of the month and allowing for these on the following month, this difficulty would be avoided.

By P. O. MacBride

Labor Manager, Lunn & Sweet Shoe Company

1. (a) In industrial terms one cannot get the proper words to clearly define this subject.

(b) In medical terms you might say that it is a form of cancerous growth that never can be cured, but can be regulated through the proper methods of organization and management.

2. The method of computation used at our plant is as follows:

(a) When trying to maintain a normal force, we figure on the basis of the number of releases.

(b) When increasing our force, we use as our basis the releases.

(c) When there is a loss of workers bringing the force below normal, we then use as our basis the number of "hires."

The percentage of turnover is figured on a monthly basis, while the yearly figure shows up as an average of averages for the twelve months, which talking from a mathematical standpoint does not sound correct, but from a result standpoint according to our ideas of turnover, we feel we have the proper answer to our problem in figures.

3. In computing the turnover on a monthly basis, we take our figures on the number of employees, not from a daily basis, but according to results shown up on our weekly payrolls which we analyze not only for this purpose, but for other labor statistical reasons.

4. We know of industrial concerns figuring the labor turnover on the basis of "hires" straight through, advancing as their theory that the number of men over a year's period required to keep their plant running is the number that the hired column of their employment analysis shows, while on the other hand I have known concerns who advance the same theory on the basis of releases.

5. In my opinion the best formula to give an accurate diagnosis is the one which we are using at the present time.

* * *

By Mary B. Gilson

Employment and Service Superintendent, The Clothcraft Shops

1. Labor turnover is the ratio of the total number of employees hired during the year to the average standing payroll for the year.

2. In case there is a general reduction in the number of positions during the period, the percentage of new employees to the average standing payroll should be taken. In case there is an increase in the organization, the percentage of quitters to the average standing payroll should be taken. In the first case that amount by which the number of quitters exceeds the number of new employees will account for the reduction. In the second place, the amount by which the new employees exceeds the number of quitters will account for the increase.

3. We compute our monthly turnover on exactly the same basis as our yearly turnover.

4. Some organizations compute their turnover by the ratio of the total number of employees quitting per year to the average standing payroll for the year.

5. Under "avoidable" we classify:

E. Earnings
W. Work
T. Treatment
C. Hours or other working conditions
X. Unclassified.

Under "unavoidable" we classify:

D. Death
R. Retirement
M. Marriage
O. Promotion out of organization
L. Lay off or discharge

H. Home conditions altered
V. Left vicinity
S. Sickness or accident
PS. Sick previous to employment
N. In national service.

* * * *

By George M. Belcher

Employment Manager, W. H. McElwain Company

1. We define labor turnover as the ratio between the number of persons leaving our employ per year and the normal number of operators employed.

2. Owing to the fact that our working force remains very nearly constant throughout the year, we have figured our turnover as indicated in the answer to your question number one. We feel, however, that if the number of operators in any one factory should show a constant decrease we would get better results by using the ratio between the number of persons hired per year and the average force employed.

3. Our labor turnover is figured each month and the average number of operators is obtained by averaging the number of weekly pay envelopes distributed during that month.

4. The figures which we lay the most stress on are the monthly figures for labor turnover computed by dividing twelve times the number of persons leaving our employ in that month by the average number of persons receiving wages, as explained in the answer to your question No. 3. We also carry a cumulative percentage figured monthly for each of our two six-months' shoe making seasons. This figure at the end of the season is the most accurate test of our labor turnover condition.

* * * *

By C. D. Morris

With R. Wallace & Sons Mfg. Co.

1. We based our plan largely on that outlined by the Boston Employment Managers' Association, only changing the classifications somewhat to suit our local conditions.

We speak of "labor turnover" in terms of percentage, meaning the number of workers leaving our employ per one hundred of employees, the number of employees being taken as the average number in our employ the first and last days of each month.

2. Regarding your second question, our number of employees has not changed to so large an extent during the time that we have been keeping a record to necessitate our considering any other than the one way of computing turnover so that (a), (b) and (c) are computed alike.

3. In computing our turnover for a particular month the only average we use is the average of number of workers in our employ the first and last day of the month. We have no other method of computing turnover and have not as yet studied the matter sufficiently to suggest one.

5. Regarding your fifth question, we do not think we have had sufficient experience to express a decided opinion. Where the number of employees does not fluctuate largely it would seem that the single percentage as used by us, classified into the different causes, was sufficient.

* * * *

By W. S. Field

Office of the Quartermaster General of the Army

1. Labor turnover is based upon number of employees leaving employment, for reasons which, in whole or in part, may be within the control of the management, and the average number of employees in employment.

2. Labor turnover is computed by finding the percentage ratio which the number leaving bears to the average number employed, and no variables such as noted after (a), (b), and (c), of your question, are considered.

3. In the Employment Managers Association of Boston, it was decided to follow the practice of taking the average of the number of employees in service at the beginning of the month and the number of employees in service at the end of the month, as the average for the month.

The writer did not, at the time, believe that this provided a sufficiently accurate average, yet it was adopted by the association, and we have made our turnover figures on that basis.

5. I believe that the method indicated under No. 2 is the most satisfactory. An attempt to consider the multitude of variables which may enter into the question of turnover would simply confuse matters.

* * * *

Report of Special Committee of National Employment Managers' Conference

The percentage of labor turnover for any period considered is the ratio of the total number of net hirings during the period to the average number of employees on the force report during that period. The force report gives the number of men actually working each day as shown by attendance records.

It is recommended that the percentage turnover be computed for each week. All turnover percentages for a week or for any other period should always be reduced to a yearly basis and be reported in terms of percentages per annum.

EXAMPLE 1.

Number of employees at first of week...... 1,000
Number of employees hired during week.... 200
Number of employees at the end of the week 100

Daily force reports: (1), 1,000; (2), 1,000; (3), 1,025; (4), 1,050; (5), 1,065; (6), 1,100.

Average of six weekly force reports, 1,040.

Net hirings = 200 — (1,100 — 1,000) = 100.

$$\text{Percentage of turnover} = \frac{100}{1{,}040} \times 52 \text{ (weeks)} =$$

500 per cent. per annum.

EXAMPLE 2.

Number of employees at first of week.... 1,100
Number of employees hired during week.. 200
Number of employees at end of week...... 1,000

Daily force reports: (1), 1,100; (2), 1,065; (3), 1,050; (4), 1,025; (5), 1,000; (6), 1,000.

Average of six weekly force reports, 1,040.

Net hirings = 200.

(Since force was decreased, net hiring was the same as the total hiring.)

$$\text{Percentage of turnover} = \frac{200}{1{,}040} \times 52 \text{ (weeks)}$$

1,000 per cent. per annum.

The above report was discussed at length by the Conference. After consideration the committee's definition was rejected because it was based on net hirings, and in its place the basis of separations was adopted including quits, discharges and layoffs. The average number actually working was adopted, without debate, as the proper base upon which to compute labor turnover rather than the average number appearing in the payroll.

Standard Definition of Labor Turnover and Method of Computing the Percentage of Labor Turnover

United States Department of Labor

Labor turnover for any period consists of the number of separations from service during that period. Separations include all quits, discharges, and lay-offs for any reason whatsoever.

The percentage of labor turnover for any period considered is the ratio of the total number of separations during the period to the average number of employees on the force report during that period. The force report gives the number of men actually working each day as shown by attendance records.

It is recommended that the percentage turnover be computed for each week. All turnover percentages for a week or for any other period should always be reduced to a yearly basis.

To compute the percentage of labor turnover for any period, find the total separations for the period considered and divide by the average of the number actually working each day throughout the period. Then multiply by the proper factor to reduce to a yearly basis.

EXAMPLE

Method of computing percentage of labor turnover for one week. Total number of separations during week, 300.

Daily force reports (workers actually on the job: Monday, 1020; Tuesday, 1065; Wednesday, 1070; Thursday, 1035; Friday, 1040; Saturday, 990. Average for week, 1037.

$$\text{Percentage labor turnover } \frac{300}{1037} \times 52 = 1504 \text{ per cent.}$$

Method of computing percentage of labor turnover for one year, (assuming that records of daily attendance are averaged for each month).

Total number of separations during the year, 5020.

Average number working each month as determined from the force reports or daily attendance records:

May, 2040; June, 2100; July, 2000; August, 1980; September, 2200; October, 2220; November, 2280; December, 2240; January, 2250; February, 2170; March, 2230; April, 2400.

Average for year = 2176.

$$\text{Percentage labor turnover } \frac{5020}{2176} = 231 \text{ per cent.}$$

In case the number employed by a plant or a department of a plant decreases because it is the deliberate policy of the plant management to reduce permanently its working force, this fact should be explicitly stated.

The Foreman of Today

By A. W. Ross

Employment Manager, Westinghouse Lamp Company

WE read almost daily of the labor difficulties throughout the United States and of the various methods of overcoming that troublesome hinderance, "labor turnover." Very few articles have appeared thus far touching on what I consider one of the most vital reasons for labor turnover, *i. e., incompetent foremen.*

Prior to the outbreak of the war a departmental foreman was lord and master of his particular group, exercising unlimited power. The employee stood in awe of this executive, knowing that to cross him in any way meant prompt dismissal. The foreman rarely took into consideration the amount of money that had been expended in bringing the operative to an efficient point, neither did he consider the value of the employee.

His requisition for help would be taken care of without difficulty. But, alas, the awakening came. The shortage of labor is upon us with the result that we are brought face to face with not a hiring and firing problem, but one of conservation. Work is plentiful, in fact firms are offering a bonus to old employees for every new employee they bring to the employment office.

In discussing the labor situation monthly with the foremen, the employment department records should show not only the total turnover for the month but a detailed report giving the loss by departments, subdivided as follows:

Name of employee,
Reason for leaving,
Length of service,
Earnings for the past four months.

Each individual case should be taken up and talked over with the chairman, who in most cases would be the superintendent leading the discussion.

Dentistry for Factory Workers

By Alfred A. Crocker

The Samuel A. Crocker Co., Cincinnati, Ohio

WE are all more or less familiar with the fact that the United States Government does not accept a man as a soldier or sailor unless he has good teeth or until his teeth have been put in proper condition. For all this there is a proper reason, although it is different from the one that used to prevail in the old time armies when a man needed good teeth to bite off the ends of paper cartridges in loading muzzle-loading rifles. The experience of the medical profession during the last 50 years has shown that if cases of tooth decay can be taken at the start, shortly after the tooth is affected, the tooth can be saved, or at least the filling of a large cavity or the putting on of an artificial crown will be unnecessary. This experience has also shown that during the period between the starting of tooth decay and the final period of painful aching there has been a gradually increasing sapping of the patient's strength and energy which may amount to any degree from lassitude to debility. Many a dentist says to a patient, "Why didn't you come six months ago? Then I could have saved your tooth, but now it must come out."

To prevent decay everyone should go to his dentist at least twice a year for examination. Small decays then discovered are easily cared for by small fillings. In this way large fillings, artificial crowns and artificial teeth may be largely avoided.

This system of frequent dental examinations is called "the zero system." In industrial dentistry the dentist keeps a card record of each patient's visit, and at the end of each period when an examination is due, say at the end of each six months, the worker is called into the industrial dental office, his teeth are examined, cleaned, whatever immediate treatment that may be necessary is given, a complete record is noted on a card which is prepared in duplicate, and if there is any further work that must be done, the man is referred to his family dentist. Of the two cards, the patient keeps one and the other is filed in the office of the industrial dentist.

Editorials and Comment

Labor Turnover

THE pages of our department "Employment and Labor Maintenance" in this issue are given over to a symposium of replies to a questionnaire as to approved methods of defining and computing "labor turnover." The generous reply to our request for information has permitted the fitting together of some eighteen short articles, dealing with matters of actual experience.

There are three major points upon which there is a difference of opinion.

The first can be outlined by asking the question, Shall labor turnover be determined upon the "hires" or "separations?" A committee of the Employment Managers' Association reported in favor of using the factor of net hirings.

> A percentage of labor turnover for any period considered is the ratio for net hirings during the period to the average number of employees on the force report during that period.

The conference itself, however, voted in favor of the factor "separations."

> Labor turnover for any period consists of the number of separations from service during that period, separations include also quits, discharges and lay-offs for any reason whatever.

The second major point on which there is a difference of thinking is brought out by the question, Shall the number of men employed be taken from the payroll or the actual force report?

Most of the methods given in the questionnaire base the turnover percentage on some average of the number of employees on the payroll. But the conference report, referred to above, declares in favor of using the number of men given by the force report. This is the number of men actually working each day as shown by the attendance record and is, therefore, less than the payroll record by the number of absentees.

The third point is brought out by asking the question, Shall separations be considered as all of the separations or shall so-called "unavoidable separations" be deducted before computing the labor turnover percentage?

Many of the replies refer to unavoidable separations saying that these should be deducted. Mr. Daniel Bloomfield gives a formula introducing this factor and points out that some employment managers do not consider that the unavoidable losses should be charged against the employment department. Miss Mary B. Gilson mentions ten reasons for leaving that are considered unavoidable.

But Mr. H. H. Magowan discredits this method in these words:

> Some employment managers believe that the unavoidable exits such as deaths, draftees, imprisonments, etc., should not be considered in the light of an increase to their turnover. This viewpoint is discredited, however, when one reflects that these terminations mean extra cost to the employment department, especially at the present time when production is of the utmost importance on account of the war.

The need of the general adaptation of a uniform definition for labor turnover and a general formula for its computation was emphasized by Dr. Royal Meeker at the Rochester conference. The differences brought out in our symposium also show the need of taking steps to standardize names, definitions and formulas connected with a term that is of such large significance in employment affairs.

Today's After War Responsibilities

WE are almost surfeited with the question, After the war, what? We have often turned eagerly to something that promised to give us an interpretation of after war conditions—it is more charitable to say interpretation than prophecy or prediction, although the latter were evidently in the minds of some of the writers.

While it is a bit fruitless to speculate about after the war, it is very much in order to consider today's responsibilities with their reference to after-war conditions. In fact some of the things that must be done on a large scale at the close of the conflict should begin now, for the opportunity is already with us.

There are a few things that we can consider as certainties. When demobilization comes the returning soldiers and sailors must be absorbed into industry. We have no wild lands that they can go to as did the veterans of 1865.

We can also be sure that these returning men will ask for a greater control of their working conditions than was even thought of before the war broke out. For the workers of today are already reaching forward to that control and are taking it in a large degree.

We may likewise be positive that the women who are now entering industry will stay in large numbers. They will not want to give up the independence that they have achieved, nor will their employers want to see them go. It has been demonstrated time and time again that women are very efficient workers.

When we accept these few things as at least reasonable certainties, for they are already with us in greater or less degree and not conditions that will spring new born at the close of the war, we may properly ask, What are some of the responsibilities of industrial managers in dealing with present conditions, and in preparing for these same conditions as they will be extended a few years hence? Perhaps the one thing that demands closest scrutiny is the return of the disabled or partially disabled soldier. England, France and Canada already have these men in large numbers, and are dealing with the problem of rebuilding them into the industrial structure of the nation. Within a very few weeks we, likewise, will begin to have these men in appreciable numbers.

What are we going to do to help make them efficient producers?

Perhaps one of the first things is the matter of education of the returned warrior as to his own responsibility toward himself and toward his community. He has given freely of his best in the cause of his country, every one is glad to extend to him this great credit, but does it follow that because of that sacrifice his country must forever support him in effortless idleness?

The mental situation in this particular is one that must be handled with tact. The man who has lost an arm or a leg is hardly in a mood to be told that he must now begin to work hard and become a producing member of society—for has not his sacrifice been one of the things that has preserved that very same society that now is suggesting new efforts in some humdrum industrial occupation?

Is it not probably true that the man who has been maimed is in no frame of mind to be talked to about other exertions and new sacrifices?

But it is evident that these men for their own good as well as for the good of society must become producing members. Is there any way in which the maimed soldier can be brought to an understanding of all this, except to show him convincingly that if he does not become a producing worker it is going to be much the worse for him?

To be thus convincingly shown demands some kind of education.

Along with the viewpoint that the community owes much to the one who has suffered greatly, is the mental disturbance brought about by shell shock, by the unrestrained life of the camp at least in regard to many acts of personal conduct, by the breakdown of responsibility because every personal need has been looked after by others for a long period and, perhaps, by a disregard for many of the ordinary things of life, which is best pointed out by the fact that ordinarily men do not kill but that for months the sole object of the soldier and sailor has been to kill.

All of this breaking away from the usual trend of thinking and acting must be overcome and normalized. So here lies another great task of education.

And then there is a third—the training in some industrial trade or occupation so that the returned soldier or sailor can acquire the necessary manual skill to become an effective producer.

Thus from three angles there must be planned and carried out the most tactful kind of training in order to win back and bring back the returned members of our army and navy into industrial life.

Whose responsibility will this training be? The natural reply is, the Government's—and this reply within wide limits is a true one. But finally much of this training must devolve upon the industries.

For years the old topic of industrial training has been discussed and threshed out in this country, and, in spite of all, the developments that have been really worth while have taken place within the industrial plants themselves. Anyone who has been in touch with trade training methods and results in the years immediately preceding the outbreak of war will agree that specialized trade training must be undertaken by industry at large.

So here is a real responsibility of today in connection with after the war conditions. Now is the time to do the work of careful planning so that as our soldiers and sailors begin to come back with their honorable discharges they may pass at once into a period of education that will fit them to become proper members of our industrial life. They are in, for them, after war conditions and this training should be begun before there has been such a break with the army or navy life that permanent idleness has set in.

Why of the Garabed Motor "Mystery"

NOT until after the death of John W. Keely did the scientific and machinery building world come to know the real inwardness of the Keely motor. But from that time to this he has always been thought of as a conscious humbug.

The latest claimant to the honors of having discovered "free energy generation" is Garabed T. K. Giragossian.

For some time the daily papers have printed synopses of his claims to having invented a motor that would run itself and generate energy "without expense."

But just examine the course that this alleged inventor has taken. From the outset he refused to submit his discovery to the United States Patent Office and have it reviewed by the experts of the Government. Had he done this and profited by their reports, he might have been saved expense and mortification. Instead he turned to the daily papers and carried on a correspondence with high government officials in which such expressions as "stopping the war" and "rocking the world" were used. At length he interested Congress in a machine that he said had been "ready since 1915," and whose principles could be demonstrated to any group of men "in twenty minutes." At length congressional action was taken and a committee of five scientists investigated the discovery and reported to the Secretary of the Interior, Mr. Franklin K. Lane, on June 29 that the widely heralded Garabed machine for creating energy was based on "unsound principles"; that the device was "non-operative" and would "not result in the practical development or the utilization of free energy." But such a situation is not closed until the engineering and industrial world knows what unsound principle the deluded inventor was following.

We are, therefore, grateful to the *Philadelphia Public Ledger* for having supplied this final bit of information. In the issue of August 11 that paper published a letter written by Mr. James A. Moyer, Chairman of the commission that investigated the Garabed device under the authority of Secretary Lane. Mr. Moyer describes one of the Garabed machines in some detail showing that it consisted essentially of a large flywheel mounted on bearings having a small coefficient of friction, and provided with a system of magnets and electrical connections that received a small amount of energy from a few dry cells. By means of a system of pulleys and belts a man could start this device rotating. The small amount of electrical current from the cells would then supply energy to overcome the mechanical friction of the flywheel bearings and the wind resistance of the revolving mass. A prony brake was also provided and used for stopping the device.

Quoting now from Mr. Moyer's letter as published: "The principal scientific fallacy throughout all of this discussion is mistaking force for energy. The method described of using the prony brake should not have been used for measuring horsepower, but only for measuring the flywheel effect of a revolving mass. Similarly, in the pulley device used for starting, it cannot be said that just because the force produced by the device was possibly one hundred times larger than the force applied that any new energy was made available.

"Many conscientious inventors and promoters have failed because they did not understand the difference and the relations between force and energy. In some cases, they have been fooled by static forces, in others, by kinetic or moving forces. Virtually every 'free energy' machine which has ever been designed has consisted of a complicated system of gears, pulleys, weights and virtually frictionless shafts."

So, Giragossian's mistake has been confusing force and energy. In this he has followed in the footsteps of many another dreamer, who failed to grasp the homely fact that "you cannot get something for nothing." He was out of step with nature's laws, and failed utterly to profit by the experience of others, or from the great store of the world's scientific knowledge. Congress has no time to waste on deluded inventors and the money of the people of the United States is too precious to waste on impossible devices. Giragossian and every other inventor should be compelled to take the regular course for inventors, that is, through the doors of the United States Patent Office, and under the scrutiny of its experts.

* * *

The official report of the Garabed commission made to Secretary Lane is as follows:

"Inclosure 15,701.

Department of the Interior,
Office of the Secretary.

We, the undersigned, who are members of the commission duly appointed in accordance with the provisions of Public Resolution No. 21—65th Congress, hereby certify that Mr. Garabed T. K. Giragossian showed us on Saturday, June 29, 1918, a model embodying the principles of his invention known as the "garabed." We found that the model was not in shape to run or to develop power. The inventor admitted that he had no working machine and that he was merely explaining principles. We do not believe that his principles are sound, that his device is operative, or that it can result in the practical development or utilization of free energy.

Witness our signatures at Boston, Mass., this 29th day of June, 1918.

(Signed)

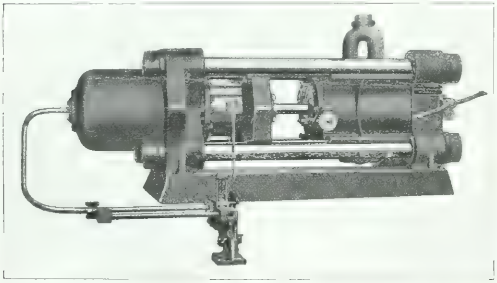
James A. Moyer, Director, Mass. State Board of Education.
Edward F. Miller, Mass. Institute of Technology.
M. DeKay Thompson, Mass. Institute of Technology.
Edward B. Wilson, Mass. Institute of Technology.
Charles L. Norton, Mass. Institute of Technology.

Factory Equipment News

The Latest Labor-Saving Machinery

Lead Cable Covering Press

A HYDRAULIC press for applying lead covering to electric cables, designed by Mr. R. Poliakoff and built by the Southwark Foundry & Machine Co., of Philadelphia, Pa., is shown in the accompanying illustration.



POLIAKOFF COVERING PRESS FOR LEAD CABLES

The cable to be covered is fed into the press through roller guides. It passes through bushings and comes in contact with the molten lead which fills a ring space between the bushing and a die. Through this die the cable is drawn after it has been covered. The action of this die is to smooth off the surface of the lead and reduce the covering to the required diameter. As the cable comes out of the press it is leaded and completely finished ready to be wound on the receiving drum.

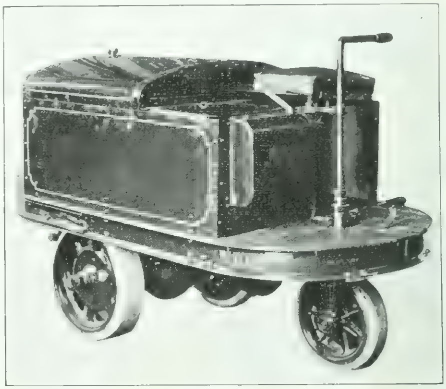
Very briefly the mechanism consists of two cylindrical chambers filled with lead, two bushings for the cable and the finishing die. The hydraulic part of the press keeps a definite pressure constantly upon the molten lead. As the supply of lead in the chambers is reduced, the controlling rods shift in position until they have reached the extreme of their movement toward the right. The drawing of the cable is then stopped, the rods are moved back to their original position by shifting the rod, and the press chambers are re-filled with molten lead and the drawing of the cable is then continued.

As the parts which come in contact with the molten metal wear faster than others they must be adjusted and repaired from time to time. To facilitate this operation the press has been so designed that all of these parts can be easily removed.

A "Mercury" Tractor

THE general dimensions of the tractor illustrated herewith, known as "Mercury Type L-3," are as follows: Length over all, 69 inches; width over all, 39 inches; height from floor to frame, 17¼ inches; wheel base, 39 inches; tread, 30½ inches; turning radius, 56 inches outside of frame; size of rear wheels, 20x3½ inches; size of front wheels, 15x3½ inches.

The main frame consists of one-piece of 4-inch channel iron bent to shape and welded to form a continuous piece. The other frame members are 3 or 4-inch channels. The battery hood is of sheet iron braced with angles and riveted throughout. The back of the hood is made of ¼-inch sheet steel to prevent bending and destruction under severe conditions of use.



TYPE L-3 MERCURY TRACTOR

The tractor is steered by a lever handle directly attached to the front wheel. The motor controller is of the drum type, having three speeds forward and three in reverse. The controller is located on the front of the machine in a readily and accessible position. The controller fingers are of the reversible type, having four interchangeable wearing surfaces.

The motor is of a series type, and the drive is direct from the motor through reversible gearing to the rear axle. The differential is of the pinion bevel gear type, designed especially for tractor service.

The power plant is of unit construction so that motor and driving gear can be detached from the frame without destroying the alignments. All bearings throughout the power plant are Timken roller, with the exception of the motor shaft bearings which are of a standard radial ball type. The axle and differential gears are of special grade alloy heat-treated steel. The wheels are cast iron carrying the standard pressed-on type of solid rubber tires. Oiling is accomplished by the usual splash system.

The brake is operated by a foot pedal and contracts upon a drum mounted on the worm shaft. The brake is also actuated by a spring controlled by the driver's seat so that the brake is automatically set whenever the driver is not in position on the seat. The controller is also returned automatically to the off position when the driver leaves his seat.

The tractor is regularly equipped with two U-bolts on the rear of the frame for chain hitches, and with a central eye bolt spring coupler. Coupling can also be arranged for in front, if desired.

This machine is manufactured by the Mercury Manufacturing Co., Chicago, Illinois.

Power Operated Temperature Instruments

THE Leeds & Northrup Co., of Philadelphia, Pa., has developed a line of power driven recording instruments for measuring and controlling temperatures in connection with high temperature furnace work.

Early attempt to use a galvanometer for this purpose employed a construction where the pointer of the instrument closed an electric circuit. This arrangement proved unsatisfactory for two reasons: with low voltages the pointer would not make contact through particles of dust, and with higher voltages the pointer would fuse to the contactor. In the instruments referred to here the pointer merely serves as a mechanical trigger. A reciprocating part, kept in constant motion by a small electric motor, is arranged not to strike the pointer when the latter stands in the no-current position. But when this pointer moves out of this position in either direction, the reciprocating part pushes it against another part, which adjusts the potentiometer circuit. The amount of the adjustment is regulated according to the distance that the pointer has swung, that is, in proportion to the unbalanced current flowing through the galvanometer.

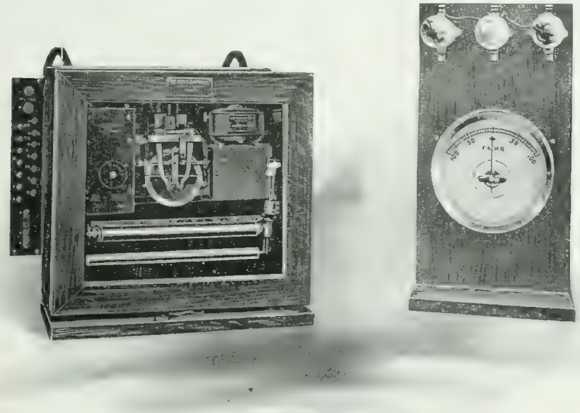


FIG. 1. AUTOMATIC TEMPERATURE CONTROLLING RECORDER

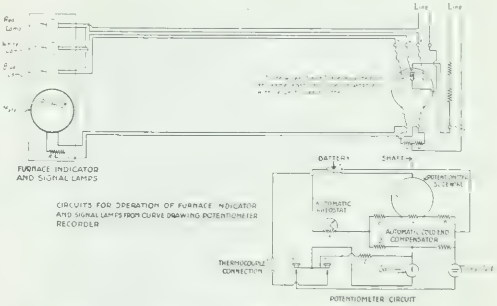

Red Lamp
White Lamp
Blue Lamp
Motor
Line
Line
FURNACE INDICATOR AND SIGNAL LAMPS
CIRCUITS FOR OPERATION OF FURNACE INDICATOR AND SIGNAL LAMPS FROM CURVE DRAWING POTENTIOMETER RECORDER
BATTERY
SHAFT→
POTENTIOMETER SLIDE WIRE
AUTOMATIC RHEOSTAT
AUTOMATIC COLD END COMPENSATOR
THERMOCOUPLE CONNECTION
POTENTIOMETER CIRCUIT

FIG. 3. AUTOMATIC POTENTIOMETER CIRCUIT

The power of the motor is sufficient, not only to make the adjustments, but also to operate the chart drum or roll. For this purpose the motor must run at a constant speed, that is, sufficiently constant to give good time-keeping qualities. To insure this result a governor of the centrifugal type has been adopted which operates by opening and closing a shunt in the field circuit. When the motor is in operation this contact is continually on the make and break to obtain the result mentioned.

The motor also supplies power to remove the recording pen. A valuable feature of the system is that the multiple instruments are constructed to record for a number of different thermocouples or resistance thermometers. In these the motor operates a selector switch which connects the recorder to the different circuits and simultaneously turns a printing wheel which impresses on the record sheet a dot to record the reading and a number to identify the individual circuit that is being measured.

When it is desired to have the signalling in regard to furnace conditions done automatically, a "single-point" or curve-drawing recorder is provided with contacts on the moving element by means of which signal lamps are lit according as the furnace temperatures are too high, too low, or correct. An extension of this plan is to use two thermocouples in different parts of the furnace and to provide the recorder with a commutator by means of

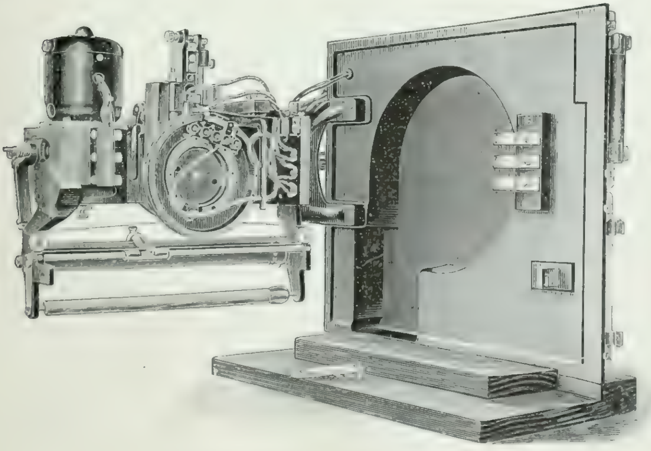


FIG. 2. LEEDS & NORTHRUP CURVE DRAWING RECORDER—OPEN

which it reads first on one and then on the other. The chart is produced in a single line running alternately back and forth between the two temperatures and indicating the temperature difference graphically. At the same time the commutator controls a fourth signal lamp at the furnace to show which thermocouple is being measured.

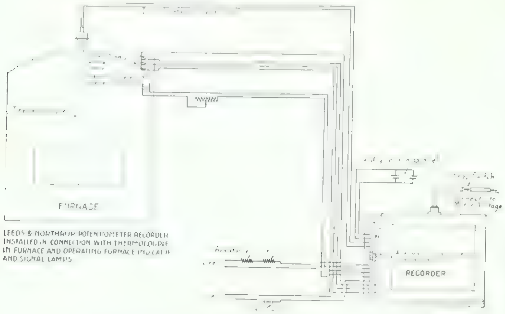

FURNACE
LEEDS & NORTHRUP POTENTIOMETER RECORDER INSTALLED IN CONNECTION WITH THERMOCOUPLE IN FURNACE AND OPERATING FURNACE INDICATOR AND SIGNAL LAMPS
RECORDER

FIG. 4. CIRCUIT FOR RECORDING POTENTIOMETER

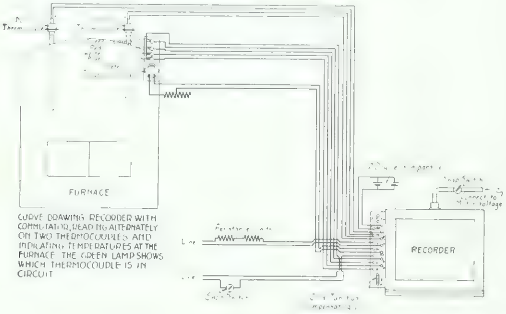

FURNACE
CURVE DRAWING RECORDER WITH COMMUTATOR, READING ALTERNATELY ON TWO THERMOCOUPLES AND INDICATING TEMPERATURES AT THE FURNACE. THE GREEN LAMP SHOWS WHICH THERMOCOUPLE IS IN CIRCUIT
Line
Line
Connect to
RECORDER

FIG. 5. CIRCUITS FOR ALTERNATE RECORDING THERMOCOUPLES

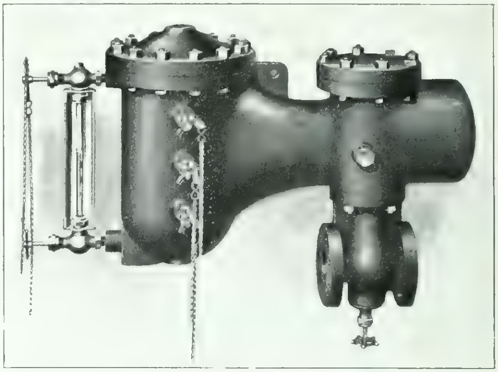
The accompanying illustrations show in Figure 1 an automatic controlling recorder with a furnace indicator and lamps Figure 2 is the curve-drawing recorder opened for examination. Figure 3 shows a circuit of an automatic potentiometer, and Figure 4 the circuit for a recording potentiometer installed in connection with a thermocouple in the furnace and operating signal lamps and a furnace indicator. Figure 5 shows the circuits for two thermocouples arranged to record alternately.

Stets Boiler Feed Controller

THE latest developments and improvements of the Stets boiler feed controller are combined in what is known as "Type B-Open Float." The accompanying illustration shows an exterior view of this instrument which is manufactured by the Williams Gauge Company, Pittsburgh, Pennsylvania.

In operating principle and general design this style is similar to style A previously manufactured. The valve construction is identical, but the casing of the style B instead of being horizontally split is provided with two large top openings through which the float lever and counterweight are placed in position and connected to the links of the valve stem.

Also instead of carrying the counterweight on top of the valve stem, a housing is provided on the end of the controller allowing the counterweight to rest in a horizontal instead of a vertical position. The fulcrum shaft on which the lever is mounted is carried in the side walls of the casing instead of by a support attached to the bottom. The shape of the large end of the casing is changed so that it may be utilized as a standard water column. Trycock tappings are provided on both sides. A water gage with valves of the quick closing lever type is mounted on the front of the casing. A shield white enamelled on the inside serves as a reflector to enable the operator on the floor to see very clearly the water level in the glass. This style B controller is built for higher working pressures than style A, namely for 350 pounds.



OPEN FLOAT BOILER FEED CONTROLLER

A controller may be set at the corner and connected to the drum with the usual steam and water piping, its water connection being provided with a blowdown at the lowest point.

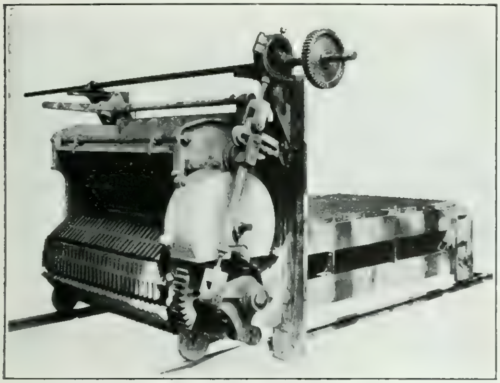
The Brady Travelling Grate

A NEW and rather novel design of travelling grate stoker has just been put on the market by the James A. Brady Foundry Company, Chicago, Illinois. The purpose in its construction has not been merely to introduce innovation in design, but the various features are the result of conservative experience.

The grate surface is self-cleaning and all of the air spaces are opened up and automatically cleaned at each revolution of the grate. The grate surface itself consists of a number of small castings two inches in width, each weighing about three pounds. These castings are identical and fit together to provide a continuous surface. At the ends of the stoker, however, where these castings pass around the sprockets they pull apart, making it possible to remove those that are burned or broken, slip new castings into their place and thus quickly make repairs. There is no stress on the grate bars, as none of the tension of the chain is transmitted to them.

The tension in the stoker is taken up in three, or more, semi-steel chains equipped with roller supports in each link. These V-shaped rollers run on steel tracks that support the grate surface in perfect alignment and prevent weaving and buckling. The aim has been to produce a steady travel and thus prevent the sifting of fine coal and provide a maximum protection to the grate surface.

Another feature of design is the absence of projection of any member of the grate surface upward into the fuel bed.



BRADY TRAVELLING GRATE

The grate surface is driven through a train of spur gears, or through a worm and wheel drive. In either construction the speed of the stoker is readily changed by changing the number of teeth that the driving pawls engage at each stroke.

The frame of the stoker is either of heavy cast iron parts or structural steel depending upon the size and conditions of installation.

These stokers are usually installed in conjunction with the Brady flat arch, another product of the same company.

International Water Softener

THE principle of water softening is to introduce chemicals (hydrated lime and soda ash are most commonly used) into boiler feed water as it enters a mechanical device or tank known as the softener. Through chemical reaction the scale-forming material is precipitated to the bottom of the tank in the form of a sludge. It is, of course, necessary that the chemicals be thoroughly mixed with the incoming water. The International Filter Company of Chicago, Illinois, has recently brought out the filter shown in Figure 1. It has an automatic control in the interior of the main softening tank. The water admission is under a float control so arranged that the rate of flow is the same regardless of the pressure on the supply line. The raw water and the softening chemicals are measured so that a predetermined ratio between the two is constantly maintained.

Referring to Figure 2 the raw water enters through pipe *A*, and discharges into the reaction chamber *E* through a deflecting elbow at *B* and the orifice *G*. It here meets the stream of lime and soda ash solution, as this is discharged at an angle the mixture is forced against the wall of the circular reaction chamber in such a way as to maintain a stirring or whirling motion in its downward course. This motion insures the thorough mixing of water and chemicals — the chemical reaction taking place in the reaction chamber. The sludge settling in the bottom of the tank is blown out at intervals through pick-up pipes and the sludge valve *P*.

The softened water which rises in the main tank usually has a cloudy appearance due to the presence of particles just on the point of settling. For this reason the softened water is passed through a filtering apparatus which removes not only these particles, but also the last trace of suspended matter.

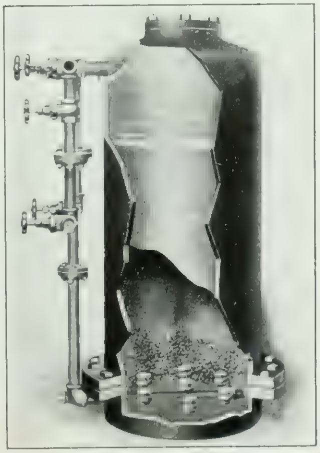


FIG. 1. WATER FILTER AND SOFTENER

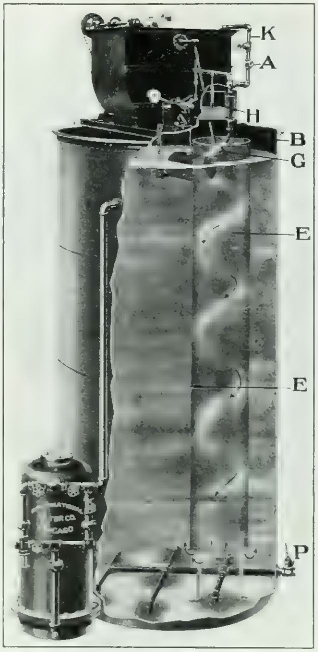


FIG. 2. INTERIOR VIEW OF WATER FILTER AND SOFTENER

The lime and soda ash are placed in the chemical feed tank on top of the softener. The tank is then filled with water from the supply pipe *K*. Inside of the tank are plow shaped agitators. These are driven by a small motor through a worm gear reduction.

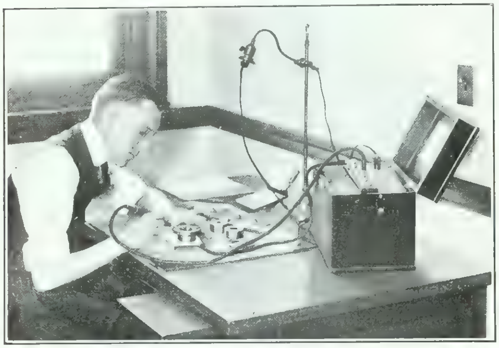
The orifice *G* is of such size that it will discharge exactly the quantity of water the softener is built to handle. Each end agitator carries a chemical measuring cup. In passing over a collector funnel the cups discharge a fixed quantity of chemicals. Any excess of chemicals that this cup picks up is, by its construction, dropped back into the tank.

As the cups are rigidly affixed to the agitators, the amount of chemical feed is always the same regardless of the depth of liquid in the chemical tank. The opening into each cup is covered by a screen to keep out all particles not in solution. The chemical cups, collector funnel and agitators are all made of cast iron to withstand the action of the chemicals employed.

The filtering apparatus is so arranged that it filters the water downward through a bed of washed and graded sand which rests on layers of gravel. The filtered water is collected in the sand valve system below the gravel bed, and from there it is discharged through the outlet valve to its destination. The filter is detached so that it may be placed at any point in the feed line.

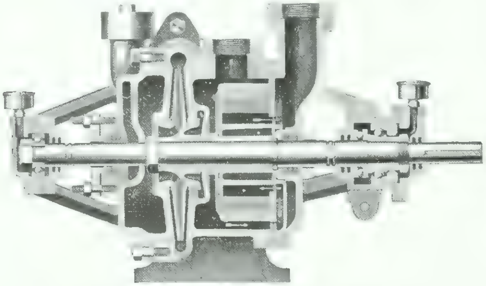
The Electro Stylograph

SMALL tools, gages, dies, etc., must be permanently marked for a number of reasons, as to indicate size, date, job number, part number, inspectors' initials, owners' name, and the like. An electric instrument for this purpose is known as the "electro stylograph" and is manufactured by the Electro Stylograph Company, New York City. The illustration shows the instrument in use, being connected to an ordinary electric light circuit. The writing is done with a stylus, and thereby does away with any possibility of damage from blows as in the common method of marking. It is claimed that the writing produced by this instrument is permanent and that it cannot be removed without machining away the surface.


THE ELECTRO STYLOGRAPH IN USE

Jennings Turbine Pump

THE Nash Engineering Company, of Norwalk, Connecticut, has placed on the market the Jennings turbine vacuum and low pressure boiler feed pump, for removing air and water from steam heating systems and returning this water to a boiler or hot-well. The general construction of the pump is shown in the accompanying illustration. It consists of two independent turbine units, an air pump and a water pump, combined in one casing with both impellers mounted on the same shaft. One unit continuously exhausts air and vapors from the heating system, and the other removes the condensate as it accumulates. The condensed water is delivered against the boiler pressure and the air and vapor, representing approximately four-fifths of the volume handled, are delivered to the atmosphere without back pressure.


NEW TURBINE VACUUM AND LOW-PRESSURE PUMP

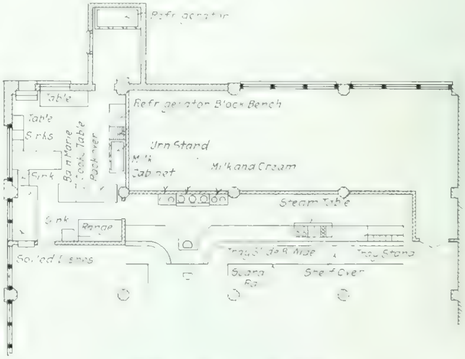
The rotor of the air pump is in hydraulic balance and revolves freely with large clearances in an elliptical casing filled with water. This water, turning with the rotor and constrained to follow the casing by centrifugal force, alternatingly recedes from and is forced back into the rotor, twice in a revolution. As the water recedes from the rotor it draws in air through the inlet ports. When the water is forced back into the rotor by the converging casing, the air is first compressed and then discharged through the outlet ports.

The water unit is a centrifugal pump specially designed to give high efficiency on either hot or cold water and to unload when not handling water. It is supplied with an enclosed bronze impeller and has renewable sealing rings. There is no contact between the impeller and the pump casing.

Factory Lunchroom

UNQUESTIONABLY the factory lunchroom has proved itself worthy, but the matter of its economic operation is by no means completely established. Many such a lunchroom is being operated today at a loss to the management, although perhaps every industrial plant that has one of these necessary adjuncts to their employees' maintenance service claims that it is trying to operate at a profit. Yet there are enough of these rooms which are being operated without loss to prove that these conditions can prevail.

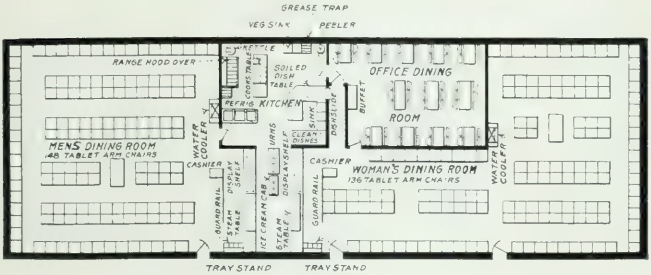
FACTORY KITCHEN, WITH GAS RANGE, GAS BROILER, BAIN MARIE JARS AND WORK TABLE



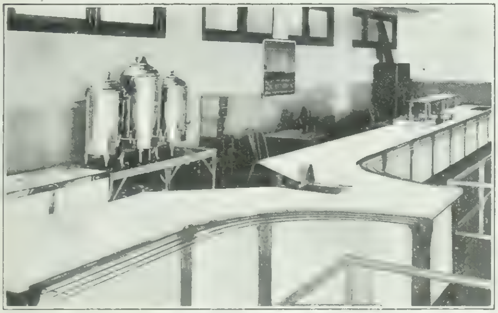
FACTORY KITCHEN ARRANGEMENT

Probably the first thing to consider is the equipment. It is possible for the factory owner to get expert advice in regard to the utilities that he should install.

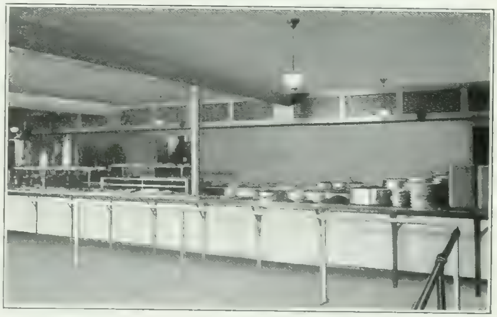
Hotel and restaurant outfitting firms have experts whose business it is to know every detail of the factory lunchroom proposition. The most recently installed factory lunchrooms are using as high-grade equipment as we find in the average commercial lunchroom or cafeteria. This means that the counter frames are of metal faced with glass and with glass tops, or perhaps faced with white porcelain and enameled steel and glass tops. The sanitary advantages of such materials is at once appreciated. Oftentimes the same kind of equipment is put in for the tables. The size of the average table for lunchroom purposes is 30 inches wide and from 4 to 10 feet long. Two running feet of table on a side is necessary to seat one person.



PLAN AND ARRANGEMENT OF FACTORY RESTAURANT



COFFEE URNS AND COUNTER MADE OF IMPROVED MATERIALS



LUNCH ROOM WITH SERVING TABLES

TRAY [illegible] FOR CAFETERIA

Various types of chairs are in use, those of bent wood or wire frame work being the more common. However, some factories use the cheaper all-wood chairs.

In other installations it has been found desirable to use stools at the tables instead of chairs. These are usually fastened to the floor much the same way as the lunch counter stools. There are also types of stools that can be folded back under the tables.

Special attention in lunchroom equipment should be given to the matter of service. Instead of a steam table 20 feet long, the average factory table is only from 6 to 8 feet long. The factory lunchroom only does business at a certain hour and for that reason does not keep food hot so long as in a restaurant. Because the service is confined to a short period it is necessary that it should be very quick, for that reason it is usually best to plan on double service. In case the factory desires to furnish coffee and milk to employees who bring their own lunch, this kind of service should be provided separately.

Steam tables are usually made of copper bodies and German silver tops. Salad pans are of similar construction.

Turning now to the kitchen equipment this should be as substantial as that in use in a good hotel or restaurant, but, of course, should be selected and arranged to care for the particular demands. The factory restaurant or lunchroom service is what might be called "family style." So the kitchen layout should conform to what is known as bulk service rather than care for a large number of separate orders. Included should be the ranges, steam kettles, vegetable steamers, work tables, Bain Maries and a dish-washing machine. Two refrigerators will probably be necessary, a large one for storage and a smaller one for the pantry. If the lunchroom does its own baking, a bakeshop refrigerator will also be needed. The bakeshop equipment would be a large portable bake oven, baker's table, pastry kettle, cake mixing machine and other articles of general equipment.

The illustrations show a few typical installations.

Personal and Business Items

The semi-annual meeting of the American Gear Manufacturers Association will be held at the Onondaga Hotel Syracuse, New York, September 19 to 21. A series of highly interesting discussions may be expected from this convention.

The American Bronze Corporation has completed an addition to its plant at Berwyn, Pa, which will triple the capacity of this firm for the output of Non-Gran Bearing Bronze.

* * * *

The Armstrong Cork Co., Pittsburgh, Pa., have recently put out a small folder dealing with the application of Nonpareil Insulating Brick to furnaces and ovens.

* * * *

Mr. Robert Mawson, formerly partner Mawson Brothers, Providence, R. I., has recently taken up the responsibilities of publicity manager for the Quigley Furnace Specialties Co., Inc., of New York.

* * * *

The Steel City Electric Co., Pittsburgh, Pa., has recently issued Catalog No. 33, which takes the place of separate bulletins formerly put out by this firm. In this complete catalog are listed and described the complete line of electrical fixtures and fittings.

* * * *

The Automatic Transportation Co., Buffalo, N. Y., have issued an attractive 48-page catalog devoted to industrial inter-plant transportation, showing the application of various trucks and tractors to many different kinds of material handling.

* * * *

Mr. Frank L. Wurl, has recently been promoted to the position of sales engineer of the Remy Electric Company, Detroit, Michigan. For a number of years he has been connected with the developments of this firm, having had charge of their research laboratories.

* * * *

Mr. G. Charter Harrison, chartered accountant and industrial engineer, is successor to the firm of Baker, Sutton and Harrison, New York City. Mr. Harrison will specialize in the design of coördinated planning and production systems. His address is 31 Nassau Street, New York City.

* * * *

The Alpha Portland Cement Co. is issuing a series of information and service sheets showing details of concrete workingmen's houses. Typical floor plans and exterior views are included, together with all the details of framing and arrangement of the concrete and wooden members.

* * * *

The Chicago Pneumatic Tool Company, Chicago, Illinois, announces the appointment of Mr. L. C. Sprague as special representative in connection with the sale of pneumatic tools to railroads. Mr. Sprague was formerly connected with the company but more recently has been connected with the Railroad Department of The H. W. Johns-Manville Company.

* * * *

The National Pipe Bending Company, of New Haven, Conn., announces that it has just entered into an agreement with Franklin Williams, Inc., 39 Cortlandt Street, New York City, to act as its representatives in New York City and vicinity. Mr. F. N. Currier is president of the company and Mr. E. T. Franzen, secretary and treasurer.

* * * *

The Wilson-Maeulen Company, 781 East 142nd Street, New York, has just issued its twelfth catalogue on pyrometers Twenty-four pages are devoted to illustrations of the instruments themselves, diagrams of their graduations, and descriptions of their construction and use. In addition to the instruments a number of pages are devoted to thermocouples and pryometer accessories.

The Widney Company, Chicago, Illinois, has recently issued a little booklet called "Uncle Sam's Wars and His War Presidents" It is small enough to be easily carried in the vest pocket, and in addition to giving the information that its title indicates, it shows the reasons for the entrance of his counry into the present war and summarizes the outstanding facts of our first year at war. This booklet is sent *gratis* to whoever will apply.

* * * *

Mr. Joseph L. Hardig, for several years with the Curtis Advertising Company, Detroit, has been appointed director of advertising of the Remy Electric Company, of Detroit. Mr. Hardig will direct the national, trade paper and newspaper advertising of his company, which is a member of the United Motors Corporation. He will also have charge of the direct advertising to manufacturers and engineers in the automotive industry.

* * * *

The English publishing house of Sir Isaac Pitman & Sons, Ltd., has recently purchased all the existing copyrights of the numerous scientific and technical books previously issued by Messrs. Whittaker & Company of London. In the future the American agency for these works will be controlled by Isaac Pitman & Sons, 2 West 45th Street, New York. This series includes works relating to airplanes, submarines, wireless telegraphy, etc.

* * * *

The Leeds & Northrup Co., of Philadelphia, Pa., have just issued catalog 87, devoted to the Potentiometer System of Pyrometry and Temperature Control. Its sixty pages show numerous applications of the heat measuring, indicating and control systems as applied in many kinds of industry. Space is also devoted to a complete description of the various types of instruments, and specimen curves are given for the recording types.

* * * *

"Higher Efficiency" is the title of a 24-page booklet devoted to "Estes Service" and published by L. V. Estes, Inc., Chicago. The slogan inscribed on the opening page is "Estes Service Lifts Business Industries to a Higher Plane of Profits." The following pages are devoted to the qualifications of Mr. Loring V. Estes, head of the organization, a description of his policy, his staff, and his service—the latter being sub-divided under two heads "Factory Efficiency" and "Industrial Accounting."

* * * *

The Carlyle Johnson Machine Co., Manchester, Conn., announce the publication of a catalog showing the application of the Johnson Friction Cluch in machine building. Most of the illustrations show machine tools, although a few are taken from the woodworking field and still others show a printing press and textile machinery applications. A feature of the arrangement of the pages is the publication in facsimile of a letter from the manufacturer of each one of the machines illustrated.

* * * *

The Advance Felt Specialty & Cutting Co., Chicago, Illinois, has issued a booklet entitled "A New Era In the Industrial Arts." It is devoted to the theory and principles of the Wideney resiliometer. It shows the construction of this instrument, how it is used, and gives a means of establishing standard specifications for compressible material. The booklet will be of interest to any industrial executive who comes in contact with the specification, purchase or use of such materials as felt, rubber, leather, paper and the like.

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. The Explanatory Note is given in the Index Section of INDUSTRIAL MANAGEMENT, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX

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INDUSTRIAL MANAGEMENT

EDUCATION

Business

Business Training at the Universities (87404 A). 2000 w. Engr—June 14, 1918. What has been done at Cambridge, Oxford, Leeds, Sheffield, Manchester, Birmingham, Liverpool, etc.

Crippled Soldiers

See same heading under Welfare and Safety.

Drawing Room

Training Women for the Drawing Room (87324 A). Howard W. Dunbar and W. E. Freeland. Ills. 2500 w. Iron Age—July 4, 1918. Successful methods employed by Norton Grinding Co. Teaching system and results.

Employers

Education of Employers (87262). Walter N. Polakov. Address before N. A. S. E. of N. Y. City. Charts. 2500 w. Natl Engr—July, 1918. What every employer should know and practice.

Engineering Council: Its Progress and Aims (87574 A). Alfred D. Flinn. 8 pp. E Cb St L, Jl—May-June, 1918. Service performed and its obligations.

Engineers

Safety and Welfare Work in the Engineer's Education (87309 A). George H. Fellows. (Abstract.) Also discussion. 3000 w. A S M E, Jl—June, 1918. Gives schedules adopted by the faculty of Carnegie Tech., and other information.

Army Engineer School in France Standardizes Work in the Field (87624). Robert K. Tomlin, Jr. Ills. 4000 w. Eng News-Rec—July 18, 1918. Serial. 1st part. Gives courses of training to men recommended for commissions.

Training Engineer Officers for the Army at Camp Lee (87312). Frank C. Wight. Ills. 2500 w. Eng News-Rec—July 4, 1918. Fitting men for over-sea service.

Glass

Sheffield University's Glass Department (87403 A). Ills. 1500 w. Engr—June 14, 1918. The part it has played in the revival of the glass industry, made necessary by the war.

Laboratory

L'Instituto Scientifico-Tecnico Ernesto Breda (87704 B). N. Parravano. Ills. 2300 w. Industria—May 15, 1918. Industrial research laboratory of Ernesto Breda, in Milan. Apparatus, equipment and work accomplished there.

Marine

Engineering Education as Applied to Naval Architecture and Marine Engineering (87198 A). H. A. Everett. 4500 w. Am Soc Mar Dftn, Jl—April, 1918. Critical discussion of courses established.

Natural Science

Position of Natural Science in the Educational System of Great Britain (87720 A). 1400 w. Nature—June 6, 1918. Report of a British committee, with recommendations.

Research

Coöperation in Industrial Research (87616 A). 6000 w. Iron Age—July 18, 1918. Views and achievements of leading workers.

Organization of Industrial Research (87310). 2500 w. Eng News-Rec—July 4, 1918. Aims of research organization and the needs.

War Activities of the National Research Council (87686 D). George Ellery Hale. 26 pp. A I E E, Pro—July, 1918. An account of the development and work of the Council.

Vocational Training

The Evolution of National Systems of Vocational Re-education for Disabled Soldiers and Sailors (87464 N). Douglas C. McMurtrie. Ills. Also bibliography. 310 pp. Gov Print Off, Bul. No. 15—May, 1918. The organization and methods evolved.

Getting Skilled Men by Making Them (87365). Ills. 1500 w. Auto Ind—July 4, 1918. What the Norton Grinding Co. is doing to counteract present labor conditions.

FINANCE AND COST

Barometric Costs

How to Find and Use Barometric Costs (87779 A). C. W. Starker. 2000 w. Ind Man—Aug., 1918. Method of charting cost figures in order to show how changes in cost of material, labor, etc., will influence the finished cost of any unit.

Business Problems

Sees Serious Business Problems Ahead After War (87500). W. S. Kies. From address at Chicago on June 17th. 3500 w. Eng News-Rec—July 11, 1918. Discusses plans for the future of American business.

Cost System

Lot Cost System in Making Winchester Guns (87326 A). W. E. Freeland. Ills. 1500 w. Iron Age—July 4, 1918. Some of the cost forms used. Bonus payments to machine adjusters and instructors.

A Simple Flexible Cost System (87780 A). G. W. Greenwood. 1200 w. Ind Man—Aug., 1918. Outlines a method of charging up items of cost to show each one at a glance with a minimum amount of bookkeeping.

Power Cost

The High Cost of Power (87778 A). C. M. Garland. 2200 w. Ind Man—Aug., 1918. Shows that faulty design and arrrangement of apparatus are frequently causes of excessive costs for power production.

Steel Dumping

See same heading under Regulation.

Trade

American Trade Possibilities in the Far East (87511). Edward B. Bruce. 3500 w. Ry Age—July 12, 1918. (Sec. 2.) Discussion of present conditions and the future outlook.

Britain's After-War Trade Policy (87526). 2500 w. Naut Gaz—July 13, 1918. Discusses preferential tariffs, coal exports, and commercial relations with enemy countries.

Trade After the War (87548 A). Also editorial. 3800 w. Engng—June 21, 1918. Findings of the departmental committee appointed by British Board of Trade to consider the position of the engineering trades.

Japan's Growing Trade (87363). Dr. Minoru Oka, in *The Japanese Mag.* 1200 w. Naut Gaz—July 6, 1918. Remarkable progress in recent years.

Trade Economy in Relation to Australian Defence (87487 A). W. L. Raws. 3300 w. Aust Min Stan—June 6, 1918. Digest of a lecture at the United Service Institute, Melbourne, Australia.

Wages

A Method for a Compensated Wage by Index Numbers (87596 A). L. K. Comstock. 21 pp. Jl Actcy—July, 1918. Explains method.

War Budget

The Making of a War Budget (87681 D). 37 pp. An Am Acad—July, 1918. Four articles by different authors discussing how to pay for the war.

War Debt

Some Cheering Thoughts on the War Debt (87509). John G. Lonsdale. 1800 w. Ry Age—July 12, 1918. (Sec. 2.) Future business is bright.

MANAGEMENT

Coöperation

Oliver Iron Mining Co. Adopts Labor Coöperation Policy (87258). 2200 w. Eng & Min Jl—June 29, 1918. Outlines the "mutuality plan" adopted.

Efficiency

The War as a Supreme Test of the Efficiency of Business Management and of Labor (87586 A). Edward N. Hurley. 11 pp. La Eng Soc, Pro—June, 1918. Address, at Philadelphia, before the National Coal Assn.

Payment by Results: A Psychological Factor in Workshop Efficiency (87337 A). Alex. Ramsay. 2500 w. Engng—May 31, 1918. Discusses results from various systems of payment.

Employment

Methods of an Employment Office (87785 A). C. S. Rossy. 1200 w. Ind Man—Aug., 1918. Outlines a successful system.

Foremen

Getting the Foreman's Coöperation (87782 A). William F. Johnson. 2200 w. Ind Man—Aug., 1918. The problem of the relationship between the foreman and the employment manager is discussed.

Industrial Policy

After the War (87719 A). H. Louis. 1000 w. Nature—June 6, 1918. Report of British committee on Commercial and Industrial Policy after the war.

Labor

Works Committees (87723). 3500 w. Times Engng Supp—June, 1918. Report of a British committee on joint committees of managers and workmen.

Another Source of Labor Supply (87786 A). Donald A. Hampson. 500 w. Ind Man—Aug., 1918. Inmates from institutions of correction, and the mildly insane.

Minimum Turnover in Machine-Shop Labor (87792 A). Stanley H. Bullard. 2000 w. Iron Age—July 25, 1918. Principles which have guided the Bullard Machine Tool Co. and the results.

Wages and Hours of Labor in Cotton Goods Manufacturing and Finishing, 1916 (87794 A). 255 pp. U S Dept Labor, No. 239—April, 1918. Rates of wages per hour, hours of labor per week, and full time and weekly earnings, with description of the processes, etc.

Why Men Leave Their Jobs (87784 A). Henry P. Dutton. 2500 w. Ind Man—Aug., 1918. Analysis of some of the reasons, with possible remedies.

Machine Work

Managing Non-Repetitive Work (87738 A). Norman Howard. 1500 w. Ind Man—Aug., 1918. Standardization of machine work. Planning and scheduling special operations.

Managers

Les Hommes Qu'il Nous Faut Pour L'Organisation Du Travail (87707 C + D). P. Pezen. 23000 w. Revue De Métallurgie—May-June, 1918. Detailed characterization of the kind of men needed for leaders in industry.

Under New Management—The Manager (87745 A). Charles M. Horton. 4000 w. Ind Man—Aug., 1918. Last article of a series. Requirements, characteristics, habits and personality of the successsful industrial manager.

Employing the Employment Manager (87783 A). 2200 w. Ind Man—Aug., 1918. Critical discussion of the attitude of employers toward managers.

Man-Power

Man-Power Under Scientific Management (87567 A). Ills. 14 pp. Cas Eng Mthly—June, 1918. Investigation of the physical capacity of man. Necessity of replacing human power by machinery.

Manufacturing

Relation Between Production, Development and Sales (87776 A). George J. Kirchgasser. 900 w. Ind Man—Aug., 1918. The importance of factory managers knowing something about marketing.

Negro Labor

Negroes a Source of Industrial Labor (87749 A). Dwight Thompson Farnham. Ills. 5000 w. Ind Man—Aug., 1918. Conditions and problems of their successful employment.

Organization

The Spirit of the Organization (87746 A). William Judson Kibby. 2000 w. Ind Man—Aug., 1918. Appeal for better understanding between employers and workmen through improvement in aims and conduct of foremen.

Piece Work

Piece Work System in Railway Shops (87438 A). W. J. McClennan. 5000 w. Ry Mech Engr—July, 1918. Organization of methods for determining proper prices and of the forms used.

Scientific Management

Science and Administration (87718 A). W. A. J. O'Meara. 1500 w. Nature—June 6, 1918. Need of scientific methods of administration in industry. Influence of politics, etc.

Time Studies

Time Studies for Rate Setting on Gisholt Boring Mills—II (87775 A). Dwight V. Merrick. 1800 w. Ind Man—Aug., 1918. Tables showing results of detailed studies.

A Time Study of Variable Operations (87743 A). Carle M. Bigelow. 2500 w. Ind Man—Aug., 1918. Planning the piling of lumber results in greatly increased output and decreased labor cost.

REGULATION

Agriculture

Industry and Agriculture (87568 A). W. G. Cass. 7 pp. Cas Eng Mthly—June, 1918. Evils of specialization.

Economy

World Need for Economy in Industry (87747 A). W. Rockwood Conover. 2000 w. Ind Man—Aug., 1918. A call to conserve material, labor and all kinds of effort to hasten recovery from war effects.

Engineering Materials

The Standardization of Engineering Materials and Its Influence on the Prosperity of the Country (87470 N). John Wolfe Barry. "James Forrest" lecture, 1917. Ills. 32 pp. Instn C E, Pro—May 2, 1917. The work, past, present, and future of the Engineering Standards Committee.

Engineers

Socialism, Unionism, and the Engineer (87203). J. Parke Channing. 2000 w. Eng & Con—June 26, 1918. Deals with the change in England since the war. The need of engineers studying the labor problems.

Industry

Some Problems and Suggestions for the Readjustment of Industry (87599 N). David Carnegie. 10 pp. Can Min Inst, Bul—July, 1918. Serial, 1st part. Considers how to secure remunerative trade without unrestricted competition in the present number.

Labor

A Priority System for Labor Recruiting (87325 A). 2000 w. Iron Age—July 4, 1918. Preferential industries to be favored.

Labor and Capital: What Do They Want? (87569 A). F. T. Clapham. 5 pp. Cas Eng Mthly—June, 1918. The demands of each: the need of their joining hands.

Labor Efficiency in Winning the War (87680 D). 46 pp. An Am Acad—July, 1918. Eight articles by authors of commanding positions discussing various phases of the subject.

The Company and Its Employees (87538). Sidney J. Jennings. 1200 w. Min & Sci Pr—July 13, 1918. Part of presidential address at Butte, Mon. Origin of the company in Roman law: early English legislation; methods of correcting abuses.

The Mission of the United States Employment Service (87640). James A. Metcalf. 2000 w. Mfrs Rec—July 18, 1918. Explains the object of the service.

The Problem of a Chinese Labor Army (87327). Courtenay De Kalb. 2500 w. Mfrs Rec—July 4, 1918. Problems in connnection with the importation of Chinese labor.

Minerals

The War-Minerals Bill (87419). 8000 w. Min & Sci Pr—July 6, 1918. Testimony of Walter R. Ingalls before the Committee on Mines of the House of Representatives.

Organization

Milwaukee's Organization for War (87748 A). Willits Pollock. 2200 w. Ind Man—Aug., 1918. Organization of civic and industrial activities on the general staff system.

Public Utilities

Commission Control of Utilities (87417). O. F. Berry. Read before convention of U. S. Tel. Assn. 4500 w. Telephony—July 6, 1918. Deals with telephone interests in Illinois, as a typical state.

Small Industries

The Small Industry in a Democracy (87305 A). George H. Haynes. 6500 w. A S M E, Jl—July, 1918. Some of the advantages of small industries, and requirements to insure their protection and opportunities for development.

Steel Dumping

The Economics of Steel Dumping (87342 A). 1800 w. Engng—May 31, 1918. Editorial on the economics of the practice as pursued by Germany.

Steel Situation.

Government Steel Requisitions Are On Safe Side (87212). W. H. Taylor. 3000 w. Eng News-Rec—June 27, 1918. From Chicago address before conference of publishers and manufacturers. Considers Russia the key to post-war trade.

U. S. Railroads

Is It Wise to Unify the Railways Nationally? (87512). Frank W. Noxon. 2500 w. Ry Age—July 12, 1918. (Sec. 2.) A study of the aims desirable in any re-organization of U. S. railways.

The Future of the Railroads of the United States (87510). F. J. Lisman. 5000 w. Ry Age—July 12, 1918. (Sec. 2.) A suggestion for a regional system under private ownership with government representation.

Women Workers

Improved Equipment Permits Employment of Additional Women Workers (87652). Ills. 2000 w. Auto Ind—July 18, 1918. Lifting devices installed in a Detroit shop to lighten work.

WELFARE AND SAFETY

Accident Prevention

Accident Prevention Methods That Work (87744 A). William Lamkie. 600 w. Ind Man—Aug., 1918. How attention to minor details may prevent accidents.

Accidents

Accidents in the Home (87447). 2200 w. Trav Stand—June, 1918. Causes and methods of prevention, with statistical data.

Workshop Accidents (87727). 2000 w. Times Engng Supp—June, 1918. Report of British committee on health of munition workers.

Crippled Soldiers

The Duty of the Employer in the Reconstruction of the Crippled Soldier (87614 D). Douglas C. McMurtrie. 1500 w. Am Soc Ht & Vt Engrs, Jl—July, 1918. Employers patriotic duty.

Dust Inhalation

The Effects of Dust Inhalation (87359 A). J. Scott Haldane. From paper before Instn. of Min. Engrs. 3500 w. Colly Gdn—June 14, 1918. Effect on the lungs; process of elimination, etc.

Dust-Inhalation In Mines (87728). 2700 w. Times Engng Supp—June, 1918. Effect on health of miners of inhaling dust in coal mines.

Efficiency

The Effect of Long Working Hours on Industrial Efficiency (87651). 1600 w. Auto Ind—July 18, 1918. How output has been increased by a reduction of hours of labor.

Fatigue

Hours of Labor and Fatigue Elimination (87566 A). John Holloway and S. B. Scotland. 9 pp. Cas Eng Mthly —June, 1918. Observations based on experience.

Quarry Accidents

Accident Prevention in Quarry Operation (87621). William H. Baker. 2500 w. Eng & Con—July 17, 1918. From an address before the National Safety Council. Work of the Committee on Safety and Welfare at the Hannibal mills of the Portland Cement Co.

Safety

New York Central Safety-First Department (87225). 3000 w. Ry Age—June 28, 1918. Sketch of its operation.

Industrial "Safety First" (87544 A). 2200 w. Eng Rev—June, 1918. The meaning and method of development in Great Britain.

Safety Engineers

The Safety Engineer (87308 A). L. A. de Blois. 2500 w. A S M E, Jl—July, 1918. The important relation of safety engineering to other branches of engineering.

Sanitation

The Engineers' Interest in Sanitary Legislation (87575 A). E. J. McCaustland. 13 pp. E Cb St L. Jl—May-June, 1918. Their influence in promoting public health and securing more effective sanitary legislation.

MISCELLANY

Belgium

A Possible Contribution to Belgium (87790 A). Editorial. 600 w. Ind Man —Aug., 1918. A suggestion for the future industrial reconstruction of Belgium.

Enemy Property

Enemy Property (87789 A). Editorial. 600 w. Ind Man—Aug., 1918. What enemy property includes and how it must be managed.

Japan

Industrial Japan (87397 A). 3500 w. Engng—June 14, 1918. The importance of its coal, iron, steel, and shipbuilding industries.

Ramsay

Sir William Ramsay (87679 B). Richard B. Moore. Ills. 27 pp. Fkn Inst, Jl—July, 1918. Biographical sketch, reviewing his work. Also bibliography of his work.

Textile Industry

The Textile Industry in Relation to the War (87306 A). J. E. Rousmaniere. 2000 w. A S M E, Jl—July, 1918. The needs of the Government, and the response of the industry to the demands upon it.

War

An Optical War (87533). Ransom Pratt. Address before the Rotary Club, San Francisco. 1600 w. West Eng—July, 1918. Part played in war by field-glasses, range-finders, periscopes, cameras, microscopes and other optical instruments.

MECHANICAL ENGINEERING

AERONAUTICS

Aeroplanes

Some Outstanding Problems in Aeronautics (87766 A). Dr. Durand. 2500 w. Engng—June 28, 1918. Serial, 1st part. Slightly abridged paper, read before the Aeronautical Soc. of Gt. Britain. Constructive materials, size, design, motive power, fuel, etc., are discussed.

Aircraft

International Aircraft Standards (87484 B). Charles M. Manly. 3000 w. S A E, Jl—July, 1918. Present status of standardization work on materials and methods.

Report on Aircraft Supply of Great Britain and Discussion of the Difficulties Involved in Production (87[illegible]). 1500 w. A A Wkly—July [illegible], 1918. Extract from 1917 report of the War Cabinet of Gt Britain. Difficulties in the way of obtaining a supply of aircraft

Aviation

Some Fundamentals of Aviation (87773 A). William B. Stout. 2200 w. E Cb Phila, Jl—July, 1918. Engines and performance of aeroplanes.

Les Nouveaux Types D'Avions Allemands (87712 B). Ills. 3300 w. Génie Civil—June 15, 1918. New types of German and Austrian machines now in use.

Biplanes

Friedrichshafen Bombing Plane (87367). 700 w. Auto Ind—July 4, 1918. Details of one of the latest designs of German long range bombers.

The A. E. G. Bombing Biplane (87340 A). Ills. 1000 w. Engng—June 7, 1918. Notes on the capabilities and construction of the latest German aeroplane.

The English S. E. V. A. Single-Seater Fighter (87332). Ills. 1000 w. A A Wkly—July 8, 1918. Detailed description.

Design

The Lateral Dihedral (87673). John G. Hanna. Ills. 4000 w. A A Wkly—July 22, 1918. Its elementary principles as applied to design, referring to W. R. D. Shaw's article.

Engines

Complete Inspection Procedure for Airplane Engines (87364). P. J. Piccirilli. 4000 w. Auto Ind—July 4, 1918. A list of things to be checked under each of the four heads of inspection.

The 180-H. P. Mercedes Aero Engine (87340 A). Ills. 3000 w. Engng—May 31, 1918. Report issued by the Ministry of Munitions. Constructional details and test.

Flying

The Medical Aspect of Flying (87369 A). 2500 w. Flying—July, 1918. Experts explain the conditions to be met in flying, and the need of specially trained medical officers to ensure fit pilots for the service.

To avoid error, please order by title and number only.

Present-Day Problems in Aeronautics (87244). W. B. Stout. Ills. 5000 w. A A Wkly—July 1, 1918. Read before the S. A. E. Problems of design and construction, and of landing.

German Planes

German Aircraft (87730). 1000 w. Times Engng Supp—June, 1918. A new 180 h.p. Mercédès motor and a large bombing plane.

Nomenclature

Airplane Nomenclature. Also, War Airplanes of To-day (87366). Ills. 1500 w. Auto Ind—July 4, 1918. Serial, 1st part. Names of different types of planes used in warfare, and of principal parts.

Propellers

Predicting Strength and Efficiency of Airplane Propellers (87655). F. W. Caldwell. Ills. 1800 w. Auto Ind—July 18, 1918. Charts and formulae for calculating horsepower absorbed and torque delivered at given engine and plane speeds.

Air Propulsion (87351). Morgan Brooks. Ills. 1800 w. A A Wkly—July 15, 1918. Applications of the superspeed theory as it relates to propellers and blowers.

Seaplanes

American Seaplane to Fly the Atlantic (87237). Map. 3000 w. Auto Ind—June 27, 1918. Rolls Royce equipped machine carrying three men probably will go via Newfoundland and Azores in September.

Transatlantic Flight

Transatlantic Flight This Year (87243). 3500 w. A A Wkly—July 1, 1918. General Brancker's views on ways to cross the ocean in transatlantic flight.

Flight Across Atlantic Should Be Made as Soon as Possible (87368 A). William S. Brancker. Ills. 3300 w. Flying—July, 1918. The prospects for a successful flight considered promising.

Offer 10,000 Planes to Fly to France (87331). 2000 w. A A Wkly—July 8, 1918. Urges the undertaking and argues its practicability.

AUTOMOBILES

Agriculture

Steam Ploughing and Cultivating Equipment (87550 A). Ills. 3300 w. Engr—June 21, 1918. Details of modern ploughing engines and implements in Great Britain.

Electric Vehicles

The Electric Vehicle as a War Measure (87241). James H. McGraw. Ills. 2500 w. Elec Wld—June 29, 1918. Its part in the nation's transportation problem.

Headlamps

Report of the 1916-17 Committee on Automobile Headlamps (87757 C). 90 pp. Ill Eng Soc, Trans—July 20, 1918. Outline of the problem; requirements; optical principles; safety limitations, etc.

Ignition

Magneto Ignition for Farm Tractors (87300 A). J. G. Zimmerman, with discussion. Ills. 3000 w. S A E, Jl—June, 1918. Matters of importance in the proper installation of magnetos and the principles underlying their construction.

Lubrication

A New Chassis Lubrication System (87653). Ills. 700 w. Auto Ind—July 18, 1918. A scheme by which oil is fed to bearings by wicks.

Motor Transport

Recent Observations in France (87772 A). David S. Ludlum. 3500 w. E Cb Phila, Jl—July, 1918. Popular account of a trip to France to study motor transport service of the army.

Motor Vehicles in Telephone Work (87694). Ills. 1800 w. Telephony—July 20, 1918. The efficiency of power vehicles with special bodies and equipment. Requirements.

Ordnance

Types of Ordnance Vehicles (87238). Ills. 1800 w. Auto Ind—June 27, 1918. Exhibits at Dayton meeting of S. A. E.

Shock Absorbers

Shock Absorbers for Easy Riding (87301 A). Mark H. Landis, with discussion. Ills. 12000 w. S A E, Jl—June, 1918. Requisites of an ideal shock absorber and essential conditions of its design.

Standardization

Standardization at the Semi-Annual Meeting (87485 B). Ills. 20 pp. S A E, Jl—July, 1918. Division reports as accepted at June 17th meeting of the S. A. E.

Tanks

Tanks Industriels (87731 B). H. Volta. Ills. 2700 w. La Nature—June 15, 1918. The "caterpillar" principle applied to industrial tractors, excavators and other machines.

Tractor Hitches

Tractor Hitch Merits Serious Consideration (87239). J. Edward Schipper. Ills. 2500 w. Auto Ind—June 27, 1918. Governs tractive ability and steering, as well as many performance characteristics.

Tractors

Larger Engine in Happy Farmer Tractor (87654). Ills. 1200 w. Auto Ind—July 18, 1918. Details of a new model.

Tractor Friction Transmissions (87302 A). Charles A. Trask, with discussion. Ills. 5000 w. S A E, Jl—June, 1918. Description of friction transmission types and their applications.

Tractor Wheels

Rolling Resistance of Tractor Wheels (87299 A). Amos F. Moyer, with discussion. Ills. 4500 w. S A E, Jl—June, 1918. Report of detailed studies and experiments.

Trucks

Applying Engineering Principles in the Design of Trucks (87660). Norman Litchfield. 1800 w. Elec Ry Jl—July 20, 1918. Points on truck loading and the mechanical functions of the parts.

Trucks Give Express Service Between Cleveland and Akron (87441 A). Joseph Husson. Ills. 4000 w. Com Vhle—July 1, 1918. Service quicker and cheaper than railroad.

Transportation by Power Trucks (87739 A). Reginald Trautschold. Ills. 4000 w. Ind Man—Aug., 1918. How demands of industry have increased the use of storage-battery trucks. Types, power costs, etc.

Truck Operating and Maintenance Costs in New York City (87646 A). Ills. 1500 w. Com Vhle—July 15, 1918. Goodman's system produces high grade performance.

Distribution of Truck Weights (87523). P. M. Heldt. 1700 w. Auto Ind—July 11, 1918. Analysis of the weights of component parts, worked out on a percentage basis, and showing variation with truck capacity.

See also Motor Post, under Civil Engineering, Roads and Pavements.

COMBUSTION MOTORS

Diesel Engines

Four-Cycle versus Two-Cycle Diesel Engines (87764 A). 1800 w. Engng—June 28, 1918. Discusses both types and results obtained, favoring the four-cycle.

Werkspoor Marine Diesel Engines (87360 A). Ills. & Plate. 1600 w. Engng—June 5, 1918. Serial, 1st part. Detailed description.

Engines

A Type of Heavy-Oil Engine for Automotive Purposes (87298 A). C. E. Sargent. Ills. 3500 w. S A E, Jl—June, 1918. Describes a constant-compression engine of the gravity-feed type and its performance.

Possible Automotive Adaptations of Heavy-Oil Engines (87297 A). P. L. Scott. Ills. 3500 w. S A E, Jl—June, 1918. Discusses the more extended and more economic use of hydrocarbon oils and the mechanical and thermal problems.

The Semi-Diesel Oil Engine (87426). L. H. Morrison. Ills. 2000 w. Power—July 9, 1918. Some semi-Diesel engines are similar in appearance to low-compression oil engines.

Some Features of Low Compression Oil Engines (87753). L. H. Morrison. Ills. 4000 w. Power—July 23, 1918. Serial, 1st part. Reviews the principles of the two-stroke cycle type.

HEATING AND COOLING

Ammonia

Latent Heat of Vaporization of Ammonia (87563 A). Nathan S. Osborne and Milton S. Van Dusen. 34 pp. U S Bur Stds—June 24, 1918. Describes apparatus and method; theory of method, experimental details and results.

Specific Heat of Liquid Ammonia (87561 A). Nathan S. Osborne and Milton S. Van Dusen. 35 pp. U S Bur Stds—June 24, 1918. Description of apparatus and methods used, with results.

The Latent Heat of Pressure Variation of Liquid Ammonia (87562 A). Nathan S. Osborne and Milton S. Van Dusen. 5 pp. U S Bur Stds—June 24, 1918. Determined by direct calorimetric observations and by computation from the expansivity.

Cooling Systems

See same heading under Steam Engineering.

Heating Systems

Reasons for Failures of Heating Systems (87609 D). J. D. Hoffman. 10 pp. Am Soc Ht & Vt Engrs, Jl—July, 1918. Faults of construction in house building; wrong ideas in regard to ventilation, etc.

Heat Transmission

The Heat Transmission of Standard Building Materials (87607 D). A. C. Willard. 10 pp. Am Soc Ht & Vt Engrs, Jl—July, 1918. Results of tests made at the Engineering Experiment Station of the University of Illinois.

Hot-Air Plants

Reforms in the Design of Hot-Air Heating Plants Needed to Compete with Other Systems (87612 D). Charles Whiting Baker. 10 pp. Am Soc Ht & Vt Engrs, Jl—July, 1918. Gives reasons why a hot-air heating plant, properly installed, in a building of moderate size, has advantages over either steam or hot water.

Hospitals

Heating a Base Hospital (87610 D). Presly M. O'Connell. Ills. 1000 w. Am Soc Ht & Vt Engrs, Jl—July, 1918. Details of plant at Camp Dodge hospital, Des Moines, Iowa.

House Heating

A Campaign for Fuel Economy in House Heating (87611 D). Charles Whiting Baker. 1200 w. Am Soc Ht & Vt Engrs, Jl—July, 1918. Recommends the addition of an auxiliary cold air duct by which the air supply to the furnace may be taken from inside

Ice Plant

Modern Raw Water Ice Making Plant (87378 A). Ills. 2000 w. Ice & Refrig—July, 1918. A new 100-ton plant in Chicago, with up-to-date equipment.

Sixty Ton Electrically Operated Raw Water Ice Plant (87204). W. G. Walters. Ills. 1500 w. Pwr House—June, 1918. Details of London, Ont., plant.

Liquid Oxygen

Explosif A Oxygène Liquide (87710 B). Ills. 3600 w. Génie Civil—June 1, 1918. Use of liquid oxygen as explosive in the mines of Germany.

Mine Ventilation

Ventilation of Mines (87606 D). Thomas Chester. Ills. 15 pp. Am Soc Ht & Vt Engrs, Jl—July, 1918. Deals with methods of ventilation, effects, etc.

Refrigeration

Refrigeration and Ice Making (87742 A). Charles L. Hubbard. Ills. 2500 w. Ind Man—Aug., 1918. Adaptability to military camps and shipboard outfits.

Nouvelles Applications Du Froid Artificiel (87709 B). A. Fichet. Ills. 2500 w. Génie Civil—June 1, 1918. Portable refrigerating outfits, especially those for military use.

Underground

Underground Pipe Mains—Material, Depreciation, Sizes for Steam and Water (87572). Charles L. Hubbard. 2500 w. Power—July 16, 1918. Advantages and disadvantages of steel and wrought iron, for steam or water.

HYDRAULIC MACHINERY

Centrifugal Pumps

Canadian-Built Centrifugal Pumps of Modern Design (87207). Ills. 2800 w. Pwr House—June, 1918. Steam, electric and gasoline driven pumps.

Pumping Engines

Steam Pumping Engines (87579 D). Alfred O. Doane, with discussion. 11 pp. N E W-Wks Assn, Jl—June, 1918. Types are considered.

Pumping Equipment

The Past and Present Pumping Equipment of the Manchester Pumping Station (87583 D). James H. Mendell. 1200 w. N E W-Wks Assn, Jl—June, 1918. Reviews past and present equipment of the city of Manchester, N. H.

Pumping Station

The Ridout St. Station of the London Public Utilities Commission (87206). W. F. Sutherland. Ills. 3500 w. Pwr House—June, 1918. Details of the water supply of London, Ont., particularly the air-lift wells at the Ridout pumping station.

Turbines

Note Sur L'Évolution Des Turbines à Grand Vitesse (87722 C + D). M. Goupil. Ills. 2500 w. Characteristics of Francis turbines under different conditions.

MACHINE ELEMENTS AND DESIGN

Bearings

A Self-Adjusting Spring Thrust Bearing (87449 A). H. G. Reist. Ills. 2000 w. Gen Elec Rev—July, 1918. Discussion of bearing design and of the construction and operation of the self-adjusting spring thrust bearing.

Bearings for Machine Shop Equipment (87227 A). Edward K. Hammond. Ills. 11500 w. Machy—July, 1918. Serial, 1st part. Design of different forms of bearings used.

Manufacturing Wright Roller Bearings (87234 A). Ills. 2000 w. Machy—July, 1918. Considers machining parts, heat-treating, assembling and inspecting.

Gear-Teeth

Proportions of Stub Gear-Teeth (87334 A). 1800 w. Mech Wld—May 31, 1918. Systems coming into use.

MACHINE WORKS AND FOUNDRIES

Drills

The Wilt Process Twist Drill Manufacture (87232 A). Franklin D. Jones. Ills. 5000 w. Machy—July, 1918. All machining operations, except grinding are done automatically.

Drop Forging

Drop Forging Problems Discussed (87194 A). 5000 w. Iron Age—June 27, 1918. Topics discussed at the Am. Drop Forge Assn.

Faceplate Aids

Faceplate Accessories (87687 A). G. W. Smith. Ills. 600 w. Mech Wld—June 28, 1918. Aids for ordinary lathe faceplate work and for use on the boring mill.

Forgings

Forging in Dies Under the Steam Hammer (87335 A). Joseph Horner. Ills. 1500 w. Mech Wld—May 31, 1918. Serial, 1st part. Variations in methods available.

Foundry Nonessentials

Essential Foundry Output Not Yet Defined (87287). 1500 w. Fndry—July, 1918. Discusses essentials and non-essentials in casting manufacture.

Foundry Practice

Win-the-War Methods at tht Essington Foundry (87288). E. C. Kreutzberg. Ills. 3000 w. Fndry—July, 1918. How gray iron castings for ship-propulsion machinery are made at South Philadelphia.

Foundry Processes

Foundry Processes—Converter Steel Castings (87696). Charles Vickers. Ills. 2000 w. Brs Wld—July, 1918. Details of operation of a baby steel converter. Also the Stock oil-fired converter which requires no cupola.

Guns

The Madsen Gun (87352 A). Ills. 4000 w. Engr—June 7, 1918. Illustrated description of this automatic gun.

The Stokes Gun and Shell, and Their Development (87763 A). Wilfrid Stokes. Ills. 4500 w. Engng—June 28, 1918. Third Gustave Canet lecture before Junior Instn. of Engrs. Construction and operation.

Heat Treatment

Effect of Mass on Heat Treatment (87388 N). E. F. Law. Ills. 15 pp. Ir & St Inst—May, 1918. Experiments and results.

Inspection

Inspection Methods of the Future (87231 A). C. C. Marsh. 1700 w. Machy—July, 1918. Automatic inspection devices and their use.

Laboratories

Planning a Research Laboratory for an Industry (87598 A). C. E. K. Mees. 14 pp. Sci M—July, 1918. Lecture delivered in New York, April 12, 1918. Directions for the organization and establishing of such laboratories.

Lathe

21-In. Centre Sliding, Surfacing, Screw-Cutting and Taper Turning Lathe for Gun Work (87547 A). Ills. 500 w. Engng—June 21, 1918. Detailed description of lathe built in Manchester, Eng.

Milling Machines

Support for Milling Machine Arbors (87228 A). Luther D. Burlingame. Ills. 2000 w. Machy—July, 1918. Review of early designs and development of types now used.

Moving Methods

Factory Moving (87230 A). L. J. Hengesbach. Ills. 2500 w. Machy—July, 1918. Methods of efficiently solving problems arising when moving machinery into a new factory.

Munitions

Munitions of War and the Smaller Engineering Shops (87513 N). F. G. Thompson, with remarks. 20 pp. Instn C E Ireland, Trans—Vol. XLIII, 1918. Account of how the work was successfully carried out.

Converting a Factory for Munitions Manufacture (87307 A). John S. Holbrook. 3000 w. A S M E, Jl—June, 1918. The plant of the Gorham Mfg. Co., at Providence, R. I.

Nut Making

A New Nut Making Machine (87402 A). Ills. 1000 w. Engr—June 14, 1918. Details of a machine designed and patented by Ernest Hollings.

Screw Threads

Grinding and Lapping Threads (87235 A). J. E. Lindgren. Ills. 1200 w. Machy—July, 1918. Attachments, fixtures and laps used for producing accurate threads.

Shop Practice

Laying Out Angular Work (87341 A). Claude W. Hill. Ills. 1600 w. Engng—May 31, 1918. Shows the relative accuracy that may be obtained with different instruments.

Steel

Bluing Steel (87229 A). W. B. Greenleaf. Ills. 2000 w. Machy—July, 1918. Materials, arrangements and methods used on light sheet-steel work.

Tools

Results of Faulty Tool Designing (87236 A). F. B. Jacobs. Ills. 1000 w. Machy—July, 1918. Reasons for failures of tools and fixtures.

Welding

Arc Welding of Mild Steel (87293 A). O. H. Eschholz. Ills. 2200 w. Elec Jl—July, 1918. Operating factors which determine reliable welds.

Fusion Welding Fallacies (87233 A). S. W. Miller. Ills. 1500 w. Machy—July, 1918. Serial, 1st part. Reviews erroneous opinions.

Metallic Electrode Arc Welds (87439 A). O. S. Eschholz. Ills. 2000 w. Ry Mech Engr—July, 1918. Suggestions for determining the quality of the joint.

MATERIALS OF CONSTRUCTION

Alloys

The Hardness of Alloys of Non Ferrous Metals (87697). P. Ludwik. Abstract translation from *Zeit. des Ver. Deut. Ing.* 1200 w. Brs Wld—July, 1918. Results of tests.

Boiler Plates

A Cause of Failure in Boiler Plates (87387 N). Walter Rosenhain. Ills. 11 pp. Ir & Lt Inst—May, 1918. An account of a failure which presents features of importance which may afford a clue to a cause in other cases.

Bronze

Constitution and Hardness of Aluminum Bronze (87291). J. Neill Greenwood. Ills. 1200 w. Fndry—July, 1918. Abstract of paper read before Inst. of Metals. (Eng.) Investigations.

Manganese in Aluminum Bronze (87695). Charles Vickers. Ills. 1200 w. Brs Wld—July, 1918. Appears to toughen the alloy. Gives tests showing influence.

Cast Iron

Cast Iron at High Temperatures (87752). 1000 w. Power—July 23, 1918. Tests collected by the Vulcan Soot Cleaner Co.

Malleable Cast Iron (87465 N). T. Turner, with discussion and correspondence. Ills. 25 pp. West Scot I & S Inst, Jl—March, 1918. Processes used in the production, etc.

Chains

Tests of Cast Steel Anchor Chain (87192 A). Ills. 1000 w. Mar Rev—July, 1918. New casting process, with report of tests.

Corindite

On the New Refractory and Abrasive Matter Called Corindite (87346 A). Alexandre Bigot. Read before the Ceramic Soc. 1000 w. Engng—May 31, 1918. Studies of interest to the metallurgical industries of the Allies.

Glue

A Grumble About Glue (87074). Mervyn O'Gorman. 2500 w. A A Wkly—July 22, 1918. Improvements needed in the product and its use.

Metals

The Effects of Impurities on Metals (87489 N). Clifford W. Nash. 3300 w. Chem Eng & Min Rev—May, 1918. Influence upon the physical and mechanical properties.

Nonferrous Metals

Testing Engineers Discuss Nonferrous Metals (87289). 3000 w. Fndry—July, 1918. Considers specifications for babbitt metal and bronze bearings, for turntables and other movable railroad structures.

Refractories

Native Supplies of Refractory Materials in the Sheffield District (87407 A). W. G. Fearnsides. 2500 w. Ir & Cl Trds Rev—May 24, 1918. Summary account of local supplies of value.

Refractory Materials Research Committee's Report (87412 A). 2200 w. Ir & Cl Trds Rev—June 14, 1918. Serial, 1st part. First of a series of reports on the general properties of refractory materials.

Silica Products—I. Raw Materials (87406 A). A. Bigot. Abstract of paper before the Ceramic Soc. 1800 w. Ir & Cl Trds Rev—May 17, 1918. Serial, 1st part. Analytical, physical and micrographic studies.

Rubber

Science and the Rubber Industry (87393 A). J. Bretland Farmer, with discussion. 8000 w. Roy Soc Arts, Jl—June 21, 1918. Services rendered by science in the production of raw rubber, and future possibilities of assistance.

The Rubber Embargo (87247 A). Andrew H. King. Ills. 4000 w. Chem & Met Eng—July 1, 1918. Economic effects of reduced rubber supply; reclaiming old stock; use of guayule as a local source of natural substitute.

Steels

Specifications for Aircraft Steels (87521 A). 2500 w. Iron Age—July 11, 1918. Review of the address of Albert Ladd Colby.

Steels for Gears and Their Treatment (87196 A). George A. Richardson. Ills. From a paper before the Drop Forge Assn. 3000 w. Iron Age—June 27, 1918. Discusses materials available, the uses to which they are best adapted, the character of heat-treatment, etc.

Timber

Wood Preservation—The Preservative Treatment of Highway Bridge Timber (87650 A). Kurt C. Barth. 1500 w. Eng Soc Minn, Bul—July, 1918 Discusses means of prolonging the life of timber.

Tin

Economies in Use of Tin (87197 A). 1200 w. Iron Age—June 27, 1918. Suggestions for conservation of tin. Substitutes.

MEASUREMENT

Aluminum Sheets

The Testing of Aluminum Sheets (87617 A). Robert J. Anderson. 1500 w. Iron Age—July 18, 1918. Data on the annealing of similar 14-gage sheet aluminum.

Ballistics

Internal Ballistics (87344 A). 1200 w. Engng—May 31, 1918. Abstract of lecture by A. G. Hadcock, at the Royal Instn. Account of the fundamental problems from the engineer's point of view, and recent advances made.

Compressive Tests

Compression Tests on Tubular Struts (87518 N). P. F. Purcell, with discussion. Ills. 20 pp. Instn C E Ireland, Trans—Vol. XLIII, 1918. Results of tests on cylindrical sections.

Cylinder Testing

Hydraulic Tester for Gas Storage Cylinders (87339 A). Ills. 1000 w. Engng—May 31, 1918. Plant constructed by James Spurge for rapid and convenient testing.

Gas Interferometer

Gas Interferometer Calibration (87564 A). Junius David Edwards. 5 pp. U S Bur Stds—June 24, 1918. Gives a proposed method.

Laboratories

Les Laboratoires Sidérurgiques Modernes (87732 B). A. Cornu-Thénard. Ills. 3500 w. La Nature—June 1, 1918. Serial, 1st part. Equipment of French laboratories for testing steel specimens.

American Water Works Laboratories (87592 N). Jack J. Hinman, Jr. Tables. 9 pp. Am W-Wks Assn, Jl—June, 1918. Information concerning work done and conditions.

Lenses

Axial Aberrations of Lenses (87559 A). E. D. Tillyer and H. I. Shultz. Ills. 29 pp. U S Bur Stds—June 24, 1918. Discusses errors which affect the definition of a lens, and describes methods of representing graphically the central errors.

Nomograms

Nomogram for the Properties of Compressed Air (87263). M. J. Eichhorn. 4000 w. Natl Engr—July, 1918. Construction and examples of use.

Radiation

Determining the Heat Given Off by Engines and Power Piping (87648). E. V. Hill and W. J. Mauer. Ills. 1500 w. Ht & Vt Mag—July, 1918. Tests made in connection with the construction of the new Mayfair pumping station, Chicago.

Radiators

The Electric Method of Testing Radiators (87608 D). J. E. Emswiler. Ills. 9 pp. Am Soc Ht & Vt Engrs, Jl—July, 1918. Method developed at the University of Michigan. Advantages and results.

Rubber

Volumetric Determination of Free Sulfur in Soft Rubber Compounds (87279 B). H. S. Upton. 1500 w. Ind & Eng Chem—July, 1918. Method and results, conserving time and materials and giving greater accuracy.

Steam

Regnault's Latent Heat of Steam Investigations (87549 A). Frank B. Aspinall. Ills. 5600 w. Engr—June 21, 1918. Critical discussion of Regnault's results in measuring the latent heat of steam showing his conclusions to be wrong.

Steel

Rapid Determination of Carbon in Steel by the Barium Carbonate Titration Method (87280 B). J. R. Cain and L. C. Maxwell. 2500 w. Jl Ind & Eng Chem—July, 1918. Modification of the barium-carbonate titration method, giving greater rapidity.

The Failure of Short Tubular Struts of High-Tensile Steel (87475 N). William Charles Popplewell and Herbert Carrington. 13 pp. Instn C E, Pro—Paper No. 4210. Experimental results and conclusions from tests made at suggestion of the Royal Aircraft Factory

The Effect of Annealing on the Electrical Resistance of Hardened Carbon Steels (87278 B). I. P. Parkhurst. 1700 w. Jl Ind & Eng Chem—July, 1918. Résumé of previous work, with report of investigations to determine the rate of softening of quenched steels.

Sulphur Determination

A Standard Apparatus for the Determination of Sulfur in Iron and Steel by the Evolution Method (87282 B). H. B. Pulsifer. Ills. 2500 w. Jl Ind & Eng Chem—July, 1918. Use of the evolution flask and the results and advantages.

Torsion Meter

Torsion Meter for Power Transmitted by Propeller Shafts (87208). Ills. 3000 w. Pwr House—June, 1918. Details of apparatus that has proven satisfactory on board ship.

Viscosity

Viscosity Determinations in Absolute Units (87398 A). 2200 w. Engng—June 14, 1918. Describes the three oil viscosimeters in widest use, and literature bearing on the subject.

POWER AND TRANSMISSION

Crankshafts

Broken Crankshafts (87541). Maurice M. Clement. 1500 w. Pwr Pt Eng—July 15, 1918. Causes and their prevention.

Lubrication

The Lubrication of Michell Blocks (87761 A). 1200 w. Engng—June 28, 1918. Results of experimental research.

Oil Reclaimers

Centrifugal Oil Reclaimers (87552 A). Ills. 700 w. Engr—June 21, 1918. Detailed description of the Spratt oil subsider and its operation.

Power Estimates

Estimating Power Requirements of a Locality (87427). Ludwig W. Schmidt. 2200 w. Power—July 9, 1918. Conditions necessary to form approximately correct estimate, etc.

Power House

McClary's Power House Installations at London, Ont. (87205). W. F. Sutherland. Ills. 3500 w. Pwr House—June, 1918. Details of plant for factories.

Power Plants

Power Plant Classification (87542). A. P. Connor. 1500 w. Pwr Pt Eng—July 15, 1918. Questionnaire of the fuel administration on plant equipment and operation. How to fill it out.

Waste Oil

Waste Oil Troubles (87261). W. A. Taller. Ills. 2000 w. Natl Engr—July, 1918. Causes; cleaning of oily pipes, etc.

STEAM ENGINEERING

Boiler Rooms

The Air Supply to Boiler Rooms (87399 A). Richard W. Allen. Ills. 5500 w. Engng—June 14, 1918. Read before Instn of Nav Archts. Effect of the efficiency of the system on the speed of ships, etc.

Boiler Tubes

Some Causes of Boiler-Tube Failures (87425). R. Cedarblom. 2500 w. Power—July 9, 1918. How to minimize the trouble from boilers that blister and fail.

Boiler Settings

Boiler Settings—Multiple Retort Under Feed Stokers (87750). Charles H. Bromley. Ills. 2000 w. Power—July 23, 1918. One of several articles intended to help the burning of high-volatile, high-ash coals. Latest and best practice.

Coal

Industrial Coal for Next Winter (87740 A). 3000 w. Ind Man—Aug., 1918. What the Government is doing to assist consumers in procuring an adequate supply, and in using it with greatest economy.

Cooling Systems

Cooling of Condenser Water by Towers and Spraying (87699 A). E. W. Marriott. Ills. 1800 w. Aust Min Stan—June 13, 1918. Comparison.

Factory Plants

Improving Factory Steam Plants (87543). H. A. Wilcox. 5000 w. Pwr Pt Eng—July 15, 1918. Serial, 1st part. Personal experiences in attacking problems in run-down plants.

Furnaces

Adapting Furnaces to Available Coal (87285). Osborn Monnett. Ills. 1500 w. Pwr Pt Eng—July 1, 1918. Proportions and arrangements of baffles and arches in hand-fired furnaces.

Gaskets

Gaskets for Steam-Pipe Lines (87277). Zeno Schultes. Ills. 1800 w. Power—July 2, 1918. Facts regarding packing for steam lines, etc. Reasons why flanged pipe joints leak.

Pipe Explosions

Steam Pipe Explosions (87760 A). Edward Ingham. Ills. 1800 w. Colly Gdn—June 28, 1918. Principal factors responsible. Design and arrangement.

Powdered Fuel

Use of Powdered Fuel for Metallurgical Furnaces and for Steam Raising (87408 A). 2000 w. Ir & Cl Tdrs Rev—May 24, 1918. Brief account.

Power Cost

See same heading under INDUSTRIAL MANAGEMENT, *Finance and Costs.*

Soot Blowers

Soot Blowers for Horizontal Water-Tube Boilers (87276). Ills. 3000 w. Power—July 2, 1918. Various types on the market and their application to the different boilers in use.

Turbines

Getting a High Vacuum at the Turbine Exhaust (87658). Hartley Le H. Smith. 2500 w. Elec Ry Jl—July 20, 1918. Shows how the faults in condenser design are being overcome and that the place for high vacuum is in the exhaust nozzle of each turbine.

TRANSPORTING AND CONVEYING

Cableways

Les Transporteurs Aériens Dans La Guerre De Montagne (87734 B). M. Bousquet. Ills. 2600 w. La Nature—June 8, 1918. Telphers, or aerial transporters of supplies and ammunition in the mountains of the Austro-Italian front.

Conveyors

The New Gravity Bucket Conveyor of Messrs. Fraser and Chalmers, Erith (87762 A). G. F. Zimmer. Ills. 800 w. Engng—June 28, 1918. Detailed description.

Ropeways

The Ropeway in Modern Warfare (87570 A). George Frederick Zimmer. Ills. 13 pp. Cas Eng Mthly—June, 1918. The importance of the ropeway in the war.

ELECTRICAL ENGINEERING

COMMUNICATION

Cables

Computing the Speed of Receiving a Telegraphic Message Through Submarine Cables (87395 A). J. Rymer-Jones. 1600 w. Elec Rev—June 14, 1918. Explains method and its advantages.

Trunking

Estimating Trunking Requirements (87527). H. A. Buxton. 1200 w. Telephony—July 13, 1918. Method for rapidly and accurately estimating the trunking requirements for call, circuit, ring-down, or automatic trunk groups.

ELECTRO-CHEMISTRY

Electrolysis

Electrolysis (87576 A). D. W. Roper. Abstract of paper before A. E. S. of St. Louis. 14 pp. E Cb St L, Jl—May-June, 1918. A comparison of conditions in St. Louis and Chicago.

Protecting the Panama Lock Valves Against Electrolysis (87213). R. H. Whitehead. 1500 w. Eng News-Rec—June 27, 1918. Wood separators and protective coatings used to prevent corrosion between opposing metals.

Electrometallurgy

Melting Brass in a Rocking Electric Furnace (87290). H. W. Gillett and A. E. Rhoads. (Abstract.) Ills. 6500 w. Fndry—July, 1918. Development of great value to the nonferrous coating industry.

Electroplating

Preparing Metal Parts for Electro-Plating I (87292). E. P. Later. 3300 w. Fndry—July, 1918. Serial, 1st part. Polishing wheels and polishing processes, etc.

Nitrogen

Electric Power for Nitrogen Fixation (87683 D). E. Kilburn Scott. 14 pp. A I E E, Pro—July, 1918. Explains the results of the arc flame process for making nitric acid.

Rectifiers

Mercury Rectifiers for Battery Charging (87377 A). S. E. Wallace. 1500 w. Tel Engr—July, 1918. Describes an exchange unit.

Silver Sulphide

Some Electrical Properties of Silver Sulphide (87558 A). George W. Vinal. Ills. 9 pp. U S Bur Stds—June 24, 1918. Results of investigations showing peculiar electrical behavior.

Storage Battery

Lead Type Storage Battery (87669 C). H. M. Beck. 12 pp. Ry Sig Assn, Jl—June, 1918. Proper methods of handling batteries in railroad service.

ELECTRO-PHYSICS

Metallic Structure

Structure of Metals (87726). 900 w. Times Engng Supp—June, 1918. Examination of steel and other metals by X-rays from a new type of tube.

Oscillograms

Harmonic Analysis of Oscillograms (87296 A). G. H. Cole. Ills. 3300 w. Elec Jl—July, 1918. Use of the harmonic analyzer and the polar oscillograph attachments.

Radioactivity

Radium and Radio-Activity (87774 A). Charles H. Viol. 9500 w. E Cb Phila, Jl—July, 1918. Reviews the discovery and development, giving radio elements known, and related information.

Radium

The Bisulfate Method of Determining Radium (87281 B). Howard H. Barker. Ills. 2500 w. Jl Ind & Eng Chem—July, 1918. Experiments and results.

Wave-Lengths

Wave-Length Measurements in Spectra from 5600 to 9600 A (87560 A). W. F. Meggers. Ills. 24 pp. U S Bur Stds—June 24, 1918. Photographic investigation of the spectra of some of the elements in the region of longer wave lengths. Arc spectra of 20 of the chemical elements were photographed.

GENERATING STATIONS

Coöperation

Coöperation of Public-Service and Isolated Plants (87573). Ira N. Evans. 1800 w. Power—July 16, 1918. Reply to Mr. Alt's criticism of an earlier article.

Electric Power

Electric Power Supply in the Future (87353 A). 5000 w. Engr—June 7, 1918. From report of committee appointed by the Board of Trade, to consider steps to insure an adequate supply for all consumers.

Fuel

Power Plants and the Fuel Administration Situation (87286). A. P. Connor. Maps. 3000 w. Pwr Pt Eng—July 1, 1918. Information on the coal, power, and heating situation and regulations of the fuel administration during war-time.

Industrial Plants

Modern Plant of Paris Medicine Co. (87284). Ills. 1200 w. Pwr Pt Eng—July 1, 1918. Boiler room economy the chief aim.

Isolated Plants

Isolated Service for Economy (87540). Ills. 2200 w. Pwr Plt Eng—July 15, 1918. Plant of Burroughs Adding Machine Co.

Loads

Relation of Coal Situation to Central-Station Load (87240). J. R. Cravath. 1600 w. Elec Wld—June 29, 1918. Off-peak service with attractive rates is urged for isolated plant customers.

Niagara Power

Niagara Power in War Industries (87663). 1800 w. Elec Wld—July 20, 1918. Plan to distribute hydroelectric energy to war industries.

Power Factor

Power Factor and the War (87242). Will Brown. Ills. 2000 w. Elec Wld—June 29, 1918. Conditions make it essential to obtain maximum use from equipment. One way is to improve power factor.

Switchboards

Instruments for Central-Station Switchboards (87396 A). G. W. Stubbings. 1300 w. Elec Rev—June 14, 1918. The degree of accuracy desirable.

The Safe Operation of Power-Plant Switchboards (87767 A). L. Fokes. Ills. 1800 w. Colly Gdn—July 5, 1918. Serial, 1st part. Outlines methods tending to greater safety.

GENERATORS AND MOTORS

Alternators

Variation of Alternator Excitation with Load (87295 A). F. D. Newbury. Ills. 3500 w. Elec Jl—July, 1918. Factors that affect the amount of increased excitation required to maintain constant voltage with increase of load.

Commutators

Iron Commutators (87294 A). B. G. Lamme. 2000 w. Elec Jl—July, 1918. Explains reasons why iron commutators are not desirable.

Induction Motors

Induction Motor Troubles (87751). Gordon Fox. 1500 w. Power—July 23, 1918. Serial, 1st part. Troubles occurring outside of the motor are discussed in this number.

Lubrication

Lubrication and Electrical Plant (87394 A). G. Basil Barham. 2500 w. Elec Rev—May 31, 1918. Discusses lubricants, and the effect of the war on quality. Tests and results.

Reactance

Reactance of Synchronous Machines and Its Applications (87685 D). R. E. Doherty and O. E. Shirley. Ills. 88 pp. A I E E, Pro—July, 1918. Part I treats of the calculation and application of the armature self-inductive reactance of synchronous machines. Part II derives a formula for calculating the field self-induction which combines to determine the initial short circuit current.

Relays

Application of Relays to Industrial Control (87662). C. E. Clewell. Ills. 2000 w. Elec Wld—July 20, 1918. Types are considered.

ILLUMINATION

Factory Lighting

How to Plan Lighting Installation for a Factory (87639). Ills. 3500 w. Elec Rev, Chi—July 13, 1918. Rules for laying out the lighting system.

Illumination

L'Évaluation de la Lumière ([illegible] B). A. Boutaric. 4000 w. Génie Civil—June 22, 1918. Comparative values of standards of illumination by a new system of units.

Radiation

Calculation of the Constants of Planck's Radiation Equation: An Extension of the Theory of Least Squares (87456 A). Harry M. Roeser. 17 pp. U S Bur Stds, Vol. 14, No. 2—June 17, 1918. Computation of Planck's constant. Method explained.

Luminous Radiation from a Black Body and the Mechanical Equivalent of Light (87457 A). W. W. Coblentz and W. B. Emerson. 10 pp. U S Bur Stds, Vol. 14, No. 2—June 17, 1918. Applications of the curve of visibility of radiation, for the average eye.

Relative Sensibility of the Average Eye to Light of Different Colors and Some Practical Applications to Radiation Problems (87455 A). W. W. Coblentz and W. B. Emerson. 67 pp. U S Bur Stds, Vol. 14, No. 2—June 17, 1918. Investigation to determine the spectral visibility of radiation curve of the average eye.

Specifications

Standard Specifications for Incandescent Electric Lamps (87453). 10 pp. U S Bur Stds, No. 13—April 13, 1918. General specifications under which lamps are purchased for the Government, with tests.

MEASUREMENT

Conduction

Note on Electrical Conduction in Metals at Low Temperatures (87459 A). Francis B. Silsbee. 1500 w. U S Bur Stds, Vol. 14, No. 2—June 17, 1918. Experimental study of relationship to be expected between the values of critical current and critical field.

Electrons

Resonance and Ionization Potentials for Electrons in Cadmium Vapor (87565 A). John T. Tate and Paul D. Foote. 8 pp. U S Bur Stds—June 24, 1918. Experimental determination.

Meters

The Foot-Candle Meter (87758 C). C. F. Sackwitz. Ills. 10 pp. Ill Eng Soc, Trans—July 20, 1918. A small portable self-contained device for measuring illumination.

Permeameter

An Experimental Study of the Fahy Permeameter (87458 A). Charles W. Burrows and Raymond L. Sanford. Ills. 33 pp. U S Bur Stds, Vol. 14, No. 2—June 17, 1918. A critical study with conclusions. Description and operation.

Radiometry

Instruments and Methods Used in Radiometry, III (87452). W. W. Coblentz. Ills. 29 pp. U S Bur Stds, No. 319—June 17, 1918. The photo-electric cell and other selective radiometers. Applications of certain physical and chemical properties of matter as a means of measuring radiant energy.

Temperature

"Hottest Spot" Temperature in Transformers (87664). Alfred Still. 1500 w. Elec Wld—July 20, 1918. Formula for calculating maximum temperature. Application.

Transformers

A Method for Testing Current Transformers (87461 A). Francis B. Silsbee. 12 pp. U S Bur Stds, Vol. 14, No. 2—June 17, 1918. A general method outlined, and two convenient modifications.

Tungsten

Reflecting Power of Tungsten and Stellite (87460 A). W. W. Coblentz and W. B. Emerson. 10 pp. U S Bur Stds, Vol. 14, No. 2—June 17, 1918. Investigation of the reflectivity with results.

POWER APPLICATIONS

Coal Mining

Electricity in Coal-Mining Operations (87443). Frank Huskinson. Ills. 1500 w. Elec Rev, Chi—July 6, 1918. Serial, 1st part. Factors governing selection of electrical equipment, advantages of central station service.

Heating

Electricity as a Substitute for Natural Gas for Heating Purposes (87554 B). Frank Thornton, Jr., with discussion. 17 pp. Engrs' Soc W Penn, Pro—April, 1918. Fundamental features of the problem and industrial applications.

Oil Fields

Opportunities for Central-Station Power in the Oil Fields (87444). L. E. Mohrhardt. Ills. 4500 w. Elec Rev, Chi—July 6, 1918. Résumé of applications to various operations and data on horsepower requirements.

Quarries

Electrically Operated Quarry and Rock-Crushing Plant in Chicago (87256). 1500 w. Elec Rev, Chi—June 29, 1918. Electric power applied to drills, haulage, crushers, and screens.

Shipyard

Motor Drive in Structural Steel Shop of Newburgh Shipyard (87322 A). W. H. Easton. Ills. 700 w. Int Mar Eng—July, 1918. An example of emergency war installation.

War Plants

Electric Power Supply for War Industries (87661). R. J. McClelland. Map. 4500 w. Elec Wld—July 20, 1918. Shortage of power a war problem. Suggestions for its solution.

TRANSMISSION AND DISTRIBUTION

A. C.-D. C.

Converting Alternating Current Into Direct Current (87433 A). Ills. 1500 w. Ry Loc Eng—July, 1918. Explains the three different methods.

Earth Connections

Power-Station Earth Connections (87424). P. H. Adams. Ills. 1500 w. Power—July 9, 1918. Proper method of putting down earth connections for electrical equipment.

Flashing

Protection from Flashing for Direct Current Apparatus (87451 A). J. J. Linebaugh and J. L. Burnham. Ills. 4500 w. Gen Elec Rev—July, 1918. Investigation of some of the most promising suggestions.

Germany

Les Nouveaux Matériaux Dans L'Industrie Électrique (87735 B). S. Frid. 3000 w. L'Industrie Électrique—June 25, 1918. Substitutes for copper in electric installations in Germany.

Ground Connections

Ground Connections for Electrical Systems (87557 A). O. S. Peters, with bibliography. 220 pp. U S Bur Stds, No. 108—June 20, 1918. Available information concerning ground connections and their uses.

Practical Electrical Hints (87264). Terrell Croft. Ills. 2200 w. Natl Engr—July, 1918. Grounding transformer secondaries; knife-switch terminology; wiring calculations chart; splicing armature conductors, etc.

Lightning Arresters

Self-restoring Properties of Lightning Arresters (87450 A). H. G. Brinton. Ills. 2500 w. Gen Elec Rev—July, 1918. Describes the self-restoring properties of the more common types.

Split-Conductors

Split-Conductor Cables—Balanced Protection (87684 D). Ills. 28 pp. A I E E, Pro—July, 1918. Experiences of the Edison Electric Illuminating Co. of Boston in the design and application of selective balanced-protection schemes to parallel connected transmission conductors.

Switchboards

See same heading under Generating Stations.

Transposition Systems

The Design of Transpositions for Parallel Power and Telephone Circuits (87682 D). Harold S. Osborne. 40 pp. A I E E, Pro—July, 1918. Results obtained in a recent design outlining methods used and the theory upon which the work is based.

MISCELLANY

Electrical Dealers

Practical Suggestions for the Electrical Dealer (87636). M. V. Rutherford. Ills. 2000 w. Elec Rev, Chi—July 13, 1918. Details requiring attention.

Publicity Problem of Electrical Dealer (87638). Chester A. Gauss. 3000 w. Elec Rev, Chi—July 13, 1918. Serial, 1st part. How competition may be met.

Results of Goodwin Plan in Contractor-Dealer Field (87637). W. A. Scott. 3500 w. Elec Rev, Chi—July 13, 1918. Results during the first year and the future outlook.

CIVIL ENGINEERING

BRIDGES

Concrete Arch

Foundations, Forms and Concrete Distribution Mark Bridge Construction (87499). Edward W. Stearns. Ills. 4000 w. Eng News-Rec—July 11, 1918. Coffer dam leakage presents problems in James River concrete arch bridge, at Richmond, Va.

Concrete Flat Slab

Reinforced-Concrete Flat-Slab Railway Bridges (87251). A. B. Cohen. Ills. 3500 w. Can Engr—June 27, 1918. Read before Am. Concrete Inst. On the development and utility of the flat-slab system.

Highway Bridges

Recent Reinforced Concrete Highway Bridge Work in Ontario (87202). Ills. 1000 w. Eng & Con—June 26, 1918. From paper of G. Graham Reid, describing types.

India

On the Physical Features of "Adam's Bridge" and the Currents Across It, Considered as Affecting the Proposed Construction of a Railway Connecting India with Ceylon (87469 N). Francis John Waring, with abstract of discussion. Ills & Maps. 50 pp. Instn C E, Pro—Jan. 23, 1917. Methods proposed for carrying out the connection with the mainland.

Keadby

Keadby Bridge (87466 N). James Benjamin Ball, with abstract of discussion. Ills. 90 pp. Instn C E, Pro—Nov., 1916. A combined railway- and road-bridge of five spans. The lifting span is worked electrically.

Signalling and Interlocking of Keadby Deviation Railway and Bridge (87472 N). James Benjamin Ball. Ills. 25 pp. Instn C E, Pro—Paper No. 4199. Detailed description.

Viaducts

Arched Steel Cantilevers Used in Park Avenue Viaduct (87502). Harry W. Levy. Ills. 1500 w. Eng News-Rec—July 11, 1918. A new viaduct under construction across 42d St., leading to an elevated roadway at Grand Central Terminal.

CONSTRUCTION

American Construction

Engineers Convert French Beet-Sugar Fields Into Advance Depot (87314). Robert K. Tomlin, Jr. Ills. 3500 w. Eng News-Rec—July 4, 1918. Structures built for American Expeditionary Forces.

Architecture

Architects Must Put Utility Before Aesthetics (87219). 3000 w. Eng News-Rec—June 27, 1918. From article by C. H. Blackall, in Am. Architect. What constitutes an architect? The future outlook and opportunities.

Cash Register Building

58000 Square Feet of Floor Space in 30 Days (87777 A). Ills. 500 w. Ind Man—Aug., 1918. Features of construction of a new building in Dayton, Ohio, for Nat'l Cash Register Co.

Concrete

Discussion of Economy in the Design of Concrete Buildings (87578 B). 15 pp. Bos Soc C E, Jl—June, 1918. Discussion of Mr. Mayer's paper.

Recommended Practice for Concrete-Bridge Construction (87534). 4000 w. West Eng—July, 1918. General specifications prepared by engineers of the Portland Cement Assn.

Recommended Practice for Concrete Bridge Construction (87689). 4500 w. Can Engr—July 18, 1918. General specifications prepared by engineers of the Portland Cement Assn.

Contractors

The Standing and Compensation of the Building Contractor (87201). 2000 w. Eng & Con—June 26, 1918. Suggestions from a paper by W. A. Klinger for improving the status, increasing the compensation and improving the business ability of contractors.

Contracts

New Contract System Which Stimulates Efficiency Gaining Favor (87625). Henry D. Hammond. 3000 w. Eng News-Rec—July 18, 1918. The superiority claimed for the method.

Culverts

Forcing Culverts Under Roads With Hydraulic Jacks (87218). Ills. 1200 w. Eng News-Rec—June 27, 1918. Pipes up to 4-foot diameter installed at costs lower than by open-cut method.

Floor Loads

Suggested Reforms in Floor-Load Requirements of City Building Laws (87215). R. Fleming. 3500 w. Eng News-Rec—June 27, 1918. Comments on the excessive live loads specified in many codes, with suggestions tending toward uniformity.

Floors

Core Construction (87373). A. H. Bromley, Jr. Ills. 2500 w. Can Engr—July 4, 1918. Read before Am. Concrete Inst. Details of design and construction.

Foundations

Repair Work to Heavy Foundations (87414 A). Sidney Gill, with discussion. Ills. 3500 w. Ir & Cl Trds Rev—June 14, 1918. Difficulties experienced and methods adopted to overcome them. Read before Natl. Assn. of Colly. Mgrs.

Housing

How Shipyard Housing Work Is Organized and Operated (87626). 2000 w. Eng News-Rec—July 18, 1918. Organization developed by division of fleet corporation.

Ore Dock

Extension to Superior Ore Dock Built of Concrete (87211). Ills. 2000 w. Eng News-Rec—June 27, 1918. Details of Northern Pacific structure.

The 600 Ft. Reinforced Concrete Extension of N. P. Ry. Ore Dock at Superior, Wis. (87619). W. D. Engelke. Ills. 1200 w. Eng & Con—July 17, 1918. Methods of construction.

Roofs

Brick Arch Roofs (87516 N). Edward W. Stoney, with remarks. Ills. 22 pp. Instn C E Ireland, Trans—Vol. XLIII, 1918. Describes examples of arched roofs which have proved economical and successful.

Sicily

La Riconstruzione Di Messina (87702 B). Ils. 1800 w. Monitore Tecnico—Apr. 10, 1918. Serial, 1st part. Reconstruction and rearrangement of important buildings damaged by earthquake.

Tunnels

Cross Channel Tunnel (87524). Arthur Fell. Read before the London Soc. 1500 w. Naut Gaz—July 13, 1918. Brief details of tunnels agreed upon by English and French engineers.

The 7000-Foot Tunnel at Lahaina, Hawaii (87532). Fr. Koelling. Ills. 1500 w. West Eng—July, 1918. It has a 6 by 6 ft. horseshoe shaped section and is lined with concrete. Carries water for irrigation of plantations.

Warfare

Conditions and Requirements of Warfare (87310 A). James E. Cassidy. 3000 w. A S ME, Jl—June, 1918. The war of material; engineers' part; cantonments, etc.

IRRIGATION AND RECLAMATION

California

$1,500,000 California Irrigation Project Has Well Supply and 98 Miles of Steel Pipe Line (87479). 2500 w. Eng & Con—July 10, 1918. Features of project in Central Tulare County. Area devoted to production of citrus fruits.

Los Angeles

Using Los Angeles Aqueduct Water for Irrigation Purposes (87272 A). C. W. Geiger. Ills. 1200 w. Mun Eng—July, 1918. Arrangements to furnish adequate water to irrigate the beet fields.

Pumping

Methods and Costs of Pumping for Irrigation in Arkansas River Valley (87478). From bulletin prepared by J. P. Marcellus. 2000 w. Eng & Con—July 10, 1918.

Reclamation

Reclamation of Swamp Lands in Virginia-Carolina Adding to Nation's Food Supply (87481). F. W. McKinney. 2000 w. Mfrs Rec—July 11, 1918. How these swamps are reclaimed.

MATERIALS OF CONSTRUCTION

Aggregates

Slag as an Aggregate for Concrete Ships (87618 A). Curtis C. Myers. Ills. 1800 w. Iron Age—July 18, 1918. Comparison with crushed stone or pebble concretes puts slag in place of superiority.

Concrete

Effects of Grading of Sands and Consistency of Mix Upon the Strength of Concrete (87688). Llewellyn N. Edwards. Ills. 1200 w. Can Engr—July 18, 1918. Read before Am. Soc. for Test. Mat. Strength developed between ages of ninety days and one year cannot be predetermined.

Permeability of Concrete by Water (87498 N). B. J. Smart and A. Morrison. Read before Eng. Assn. of N. S. W. Ills. 2500 w. Comwh Engr—May, 1918. Concludes that concrete can be made watertight, but doubts whether it can be economically accomplished.

The Basic Principle of Concrete Mixes (87421). Duff A. Abrams. 1000 w. Min & Sci Pr—July 6, 1918. Experimental data showing increase in strength from proper proportioning.

Flumes

Precast Concrete Slabs Make Durable Flume (87628). S. L. Stovall. Ills. 1000 w. Eng News-Rec—July 18, 1918. Construction found to be cheap and simple.

Timber

Moisture Effects on Fir and Pine (87191 A). Irving H. Cowdrey. 3500 w. Mar Rev—July, 1918. Air dried timber reabsorbs moisture rapidly, and strength is reduced as moisture increases.

Timber Industry (87698 A). Percy Groom, with discussion. 12 pp. Roy Soc Arts, Jl—July 5, 1918. Deals with the extent to which technical science can aid in promoting this industry, and the utilization of the timber resources of the British Empire.

Timber Preservation

Relative Resistance of Various Hardwoods to Injection with Creosote (87691). Ills. 4500 w. Ry Rev—July 20, 1918. Details and results given in a paper by Clyde H. Teesdale and J. D. MacLeon, published as Bul. 606, U. S. Dept. of Agriculture.

MEASUREMENT

Arches

Description of a Machine to Test the Actual Horizontal Thrust of Model Arches (87514 N). Edward Waller Stoney. Ills. 1800 w. Instn C E Ireland, Trans—Vol. XLIII, 1918. Details of machine and experiments made.

Experiments on the Strength of Thin Brick Arch Ribs (87515 N). Edward W. Stoney. Ills. 32 pp. Instn C E Ireland, Trans—Vol. XLIII, 1918. Experiments made to test the actual strength and stiffness of arch ribs of sufficient size to roof houses.

Beams

Equivalent Uniform Loads for Reinforced Concrete Beams (87200). Albert J. Becker. 1500 w. Eng & Con—June 26, 1918. Method of determining maximum bending moment of equivalent uniform loads.

Chimneys

Vibration of Reinforced Concrete Chimneys (87716 N). F. Omori. Ills. 4700 w. Earthquake Committee—Bul 1, Vol. IX. Results of research undertaken for Imperial Japanese Earthquake Investigation Committee.

Columns

Tests of Large Bridge Columns (87556 A). J. H. Griffith and J. G. Bragg. Ills. 135 pp. U S Bur Stds, No. 101—June 27, 1918. Gives a comparative analysis of the experimental data found upon 18 large bridge columns.

Dams

Déversoirs Noyés (87717 C + D). G. Mouret. Ills. 8000 w. Annales Des Ponts Et Chaussées—Nov.-Dec., 1917. Graphic representation of relations deduced by experiment on flow of water over dams. Mathematical treatment and formulas.

Earth-Pressures

Experiments on Earth-Pressures (87406 N). Ponsonby Moore Crosthwaite, with abstract of discussion. Ills. 87 pp. Instn C E, Pro—Dec. 19, 1916. Report of experimental investigations.

Gravel Screens

Comparative Analysis of Gravel Screens (87622). Raymond W. Dull. Ills. 1800 w. Eng & Con—July 17, 1918. Types are described and analyzed.

Melun

Note Sur L'Arche D'Essai De Melun (87721 C + D). M. Frontard. Ills. 8600 w. Annales Des Ponts Et Chaussées—Jan.-Feb., 1918. Experimental arch bridge, 246 ft. span, at Melun, France. Measurements and calculations.

Mine Surveying

Terrestrial Magnetism in Relation to Mine Surveying (87355 A). C. Chree. From paper before Instn. of Min. Engrs. 4000 w. Colly Gdn—June 14, 1918. On the use of magnetic instruments, their accuracy, etc.

Plane Table

A New Device for Tacheometric Plane-Table Surveying (87477 N). Henry Louis. 1000 w. Instn C E, Pro—Paper No. 4226. Description.

MUNICIPAL

City Planning

El Nuevo Plano De La Habana (87701 A). P. P. Gaston. 9900 w. Rev Soc Cubana De Ingenieros—June, 1918. Suggested scheme of city improvement of Havana by entirely new layout.

Sunlight Engineering in City Planning and Housing (87209 B). Herbert S. Swan and George W. Tuttle. Ills. 2500 w. Arch For—June, 1918. Gives data required for the application.

The Technical Mind and the City Plan (87585 A). C. A. Favrot, with discussion. 27 pp. La Eng Soc. Pro—June, 1918. Points in the planning of cities.

Yorkship Village (87210 B). Charles C. May. Ills. 2000 w. Arch For—June, 1918. A housing development near Camden, N. J., for the N. Y. Shipbuilding Corporation.

Garbage

Baltimore Receives Bids for Garbage Disposal as Part of General Plan for Improved Collection and Disposal of Municipal Waste (87273 A). Walter E. Lee. 4000 w. Mun Eng—July, 1918. The refuse problem and methods of disposal.

Municipal Contribution to Conservation Through Garbage Utilization (87283 B). Edward D. Very. Also, American Garbage Disposal Industry and Its Chemical Relation. Raymond Wells. 7000 w. Jl Ind & Eng Chem—July, 1918. Deals with methods and results.

Industrial Cities

The Development of an Industrial City (87304 A). Charles G. Washburn. Ills. 4500 w. A S M E, Jl—July, 1918. Deals particularly with the development of Worcester, Mass.

Municipal Wastes

La Limpieza De Una Ciudad (87700 A). L. M. Y. Pedroso. 9900 w. Rev Soc Cubana De Ingenieros—May, 1918. City sewer systems; sewage treatment, industrial wastes, etc.

Sanitation

The Sanitary Control of Swimming Pools (87577 B). Stephen De M. Gage, with discussion and bibliography. Ills. 77 pp. Bos Soc C E, Jl—June, 1918. Aspects of the swimming pool sanitation problem.

Sewage Discharge

Forecasting Sewage Discharge at Toledo Under Dry-Weather Conditions (87217). Watson G. Harmon. 2000 w. Eng News-Rec—June 27, 1918. A study of the probable volume to be dealt with up to the year 1950.

Sewerage

Features of Proposed Sewerage Works for St. Augustine, Fla. (87269 A). 1500 w. Mun Eng—July, 1918. Types of construction and design recommended.

Sewers

Are Sewers Remunerative to Small Municipalities? (87249). Fred Alfred Dallyn. 2200 w. Can Engr—June 27, 1918. Analysis of costs and benefits.

ROADS AND PAVEMENTS

Asphalt

Practical Hints on the Design, Construction and Repair of Asphalt Pavements (87329). Charles A. Mullen. From paper before Can. Good Roads Cong. 4000 w. Eng & Con—July 3, 1918. Materials, suggestions for mixing and laying, and maintenance.

Brick

De fabricage van den Straatklinker (87736 B). A. Van De Koppel. Ills. 4600 w. Ingenieur—June 8, 1918. Manufacture of paving brick in Holland. Clay employed, drying methods, kilns, etc.

Concrete

Initial and Maintenance Cost of Concrete Roads Prove Them Most Suitable for Truck Use (87442). Ills. 1500 w. Com Vhle—July 1, 1918. Need for uniform method of accounting for construction and repair.

Proper Drainage and Adequate Thickness of Bed Important Factors in Concrete Roads (87647 A). Ills. 1400 w. Com Vhle—July 15, 1918. Experience in various places. Maintenance and service.

Contractors

Would Rate State Highway Contractors on Past Performance (87627). S. E. Fitch. 3500 w. Eng News-Rec—July 18, 1918. Propose giving contractor part of saving proportionate to speed and efficiency shown.

Earth Roads

Location of Earth Roads (87374). R. W. E. Loucks. 4000 w. Can Engr—July 4, 1918. The planning of roads, drainage, alignment, curves, etc.

The Necessity of Engineering Supervision in the Construction and Maintenance of Earth Roads (87250). H. Ross MacKenzie. Ills. 3500 w. Can Engr—June 27, 1918. Abstract of paper before Regina Branch of Can. Soc. of C. E. General principles and expert opinion, etc.

Highways

$20,000,000 Expenditure Proposed for Construction and Maintenance of Highways for Motor Truck Parcel Post Service (87330). 1500 w. Eng & Con—July 3, 1918. Plan outlined for the extension of motor truck postal service.

Maintenance

Procedure in the Use of Explosives on Road Maintenance Wórk with Specific Examples (87267 A). W. H. Dawson. 1200 w. Mun Eng—July, 1918. Work in Pennsylvania and Maryland.

Motor Post

Reports Show Results of Motor Parcel Post Service (87504). Map. 2000 w. Eng News-Rec—July 11, 1918. 50% of the gross earnings to be used in building post roads.

Pavement Costs

Ultimate Costs of Bituminous and Water-Bound Macadams Nearly Equal in New York (87503). Dudley P. Babcock. 2500 w. Eng News-Rec—July 11, 1918. Investigations made by the New York State Highway Department.

Pavements

Concrete Pavements (87690). Murray A. Stewart. From Trans. Am. Soc. of Munic. Imp. Ills. 1600 w. Can Engr—July 18, 1918. Report of experimental work to ascertain merits of different grades of concrete.

Details of Construction of Stone Block Pavements (87265 A). Arthur H. Blanchard. Ills. 2200 w. Mun Eng—July, 1918. Reviews improvements introduced during the last forty years.

Some Hints on the Construction and Maintenance of Asphalt Pavements. (87266 A). C. A. Mullen. 1500 w. Mun Eng—July, 1918.

Paving

Some Points on Force Account Paving (87649 A). Oscar Claussen. 2500 w. Af Eng Soc Minn, Bul—July, 1918. Reasons for favoring force account paving.

Road Materials

The Results of Physical Tests of Road-Building Rock in 1916 and 1917 (87462 N). Prévost Hubbard and Frank H. Jackson, Jr. 29 pp. U S Dept Agri, Bul. 670—June 14, 1918. Tabulated results.

Subgrades

Notes on Highway Design: Subgrades (87328). J. L. Harrison. 1400 w. Eng & Con—July 3, 1918. Wrong assumptions as to strength of subgrades; causes of pavement failures, etc.

WATER SUPPLY

Australia

Railway Water-Supplies in Western Australia: Difficulties Caused by Salt in Soil (87474 N). Robert Bleazby. 7 pp. Instn C E, Pro—Paper No. 4193. Explains the difficulties and methods adopted in dealing with them.

Camp Devens

The Building of Camp Devens (87581 D). Leonard Metcalf and George W. Fuller. 8 pp. N E W-Wks Assn, Jl—June, 1918. Discussions of work.

Catskill

The Catskill Water Supply System (87587 N). J. Waldo Smith. 9 pp. Am W-Wks Assn, Jl—June, 1918. Outlines this great project and its successful completion.

Dams

A New Method of Designing Masonry Dams (87471 N). Arthur Askwith Stoddard. 12 pp. Instn C E, Pro—Paper No. 4205. Results of recent investigations and their application to practical design.

Operation of Grand River Roller Dam Proves Satisfactory (87214). S. O. Harper. Ills. 1500 w. Eng News-Rec—June 27, 1918. Observations on behavior of largest of the three dams of its type in the country.

Reservoir Dams (87546 A). Ills. & Plates. 2500 w. Engng—June 21, 1918. Examples of difficult dam construction. Suggestions.

Filters

Intermediate Rate Fine-Sand Water Filter Operates Under Vacuum (87216). Ills. 1200 w. Eng News-Rec—June 27, 1918. Silty water clarified at El Centro, Calif.

Filtration

Design and Construction of New Mechanical Water Filtration Plant at Oshkosh, Wis. (87270 A). T. B. Jorgensen. Ills. 1000 w. Mun Eng—July, 1918. Details of a new purification plant.

Mechanical Filtration Plant at Lethbridge, Alberta (87372). Arthur M. Grace. Ills. 2500 w. Can Engr—July 4, 1918. New low service pumping station and relocation of intake.

Fountains

Progress Report of the Committee on Sanitary Drinking Fountains (87589 N). 1600 w. Am W-Wks Assn, Jl—June, 1918. Fundamental principles which most fountains violate. Short bibliography.

Joints

Metalium (87594 N). Homer V. Knouse. Ills. 2000 w. Am W-Wks Assn, Jl—June, 1918. Advantages claimed for this jointing material, and results of its use.

Meter Capacities

Methods of Determining and Plotting Meter Capacities and Some Results (87591 N). Fred B. Nelson. 11 pp. Am W-Wks Assn, Jl—June, 1918. Methods used and results obtained in recent meter testing of the department of water supply, gas and electricity of New York.

Milan

Impianto Di Sollevamento Di Acqua Potabile Della Città Di Milano (87705 B). F. Menorini. Ills. 2200 w. Industria—May 31, 1918. Pumping plant for water supply of city of Milan, Italy. Oil engines driving centrifugal pumps by belt.

Pipe

Prices and Depreciation of Cast Iron Pipe (87593 N). Burt B. Hodgman, with discussion. 18 pp. Am W-Wks Assn, Jl—June, 1918. Tabulated data for the past fifty years, with information and results of tests.

Pumping Equipment

A Log Book for an Electrically Driven Pumping Unit at New Bedford (87584 D). R. C. P. Coggeshall, with discussion. 7 pp. N E W-Wks Assn, Jl—June, 1918. Reproduction of a page of a log book for electrically operated centrifugal pumps.

Pumping Station

See same heading under MECHANICAL ENGINEERING, *Hydraul. Machinery.*

Pumps

Centrifugal Pumps (87590 N). E. C. York. 2000 w. Am W-Wks Assn, Jl—June, 1918. Points of importance in selection of such pumps.

Pollution

The Control of Stream Pollution—A Problem in Economics (87271 A). Earle B. Phelps. 3000 w. Mun Eng—July, 1918. Favors federal control of stream pollution.

Purification

Recent Practice in the Purification and Softening of Public Water Supplies (87517 N). Fred C. Uren, with discussion. Ills. 82 pp. Instn C E Ireland, Trans—Vol. XLIII, 1918. Modern practice in water purification.

Removal of Iron, Manganese, and Carbon Dioxide from Water (87595 N). 2000 w. Am W-Wks Assn, Jl—June, 1918. Discussion of Frank A. Barbour's paper.

Plant and Animal Life in the Purification of a Polluted Stream (87597 A). C. Elsmere Turner. Ills. 12 pp. Sci M—July, 1918. A study of the biological activity in polluted streams.

Sanitation

Recent Legislation and Decisions of the Courts with Reference to the Sanitary Protection of Water Supplies (87582 D). Albert D. Sawyer, with discussion. 13 pp. N E W-Wks Assn, Jl—June, 1918. Case of the Haverhill Water Board.

Supply Lines

Special Features of Improvements to Main Water Supply Lines of Bayonne, N. J. (87268 A). Nicholas S. Hill, Jr. Ills. 1500 w. Mun Eng—July, 1918. Outline of work of construction and repairs.

Tanks

Tanks for Water Supply (87260). Charles L. Hubbard. Ills. 4500 w. Natl Engr—July, 1918. Data regarding tanks and auxiliary equipment and methods of supporting tanks, etc.

Thawing

Thawing Out Frozen Services (87580 D). D. A. Hefferman, with discussion. 11 pp. N E W-Wks Assn, Jl—June, 1918. Experience with electric thawing apparatus. Winter of 1917-18.

Water Works

The Water Works at Camp Grant (87588 N). Charles B. Burdick. 9 pp. Am W-Wks Assn, Jl—June, 1918. Water supply for cantonment near Rockford, Ill.

WATERWAYS AND HARBORS

Australia

Harbor Development in Australia (87497 N). A. C. Mackenzie. Maps. 3500 w. Comwh Engr—May, 1918. Port development and internal lines of communication.

Baltimore

Extensive Railroad and Industrial Improvements on Baltimore Harbor (87641). Ills. 1600 w. Mfrs Rec—July 18, 1918. Important terminal improvements and industrial plants recently erected along the harbor.

Barge Canal

Fast Boats for the Barge Canal (87643). 600 W. Naut Gaz—July 20, 1918. Arrangements for service between New York and Buffalo.

British Guiana

Harbour Works in British Guiana (87720). 1400 w. Times Engng Supp—June, 1918. Harbor improvements projected at Georgetown.

Canal Rates

Railways, Waterways and Highways (87252). Edward A. Bradford, in the *Annalist.* Ills. 2200 w. Ry Rev—June 29, 1918. Critical discussion of rates for the N. Y. Barge Canal.

Canals

The New Trollhätta Canal (87338 A). Ills. & Plate. 3500 w. Engng—May 31, 1918. Serial, 1st part. Outlines the history of this canal, and describes recent extensions.

To avoid error, please order by title and number only.

Dikes

Réparation Des Dignes Du Zuyderzée (87711 B). A. Goupil. Ills. 1900 w. Génie Civil—June 8, 1918. Repair and reconstruction work on the dikes of the Zuyderzée, Holland, after 1916 storm.

Dredging

Recent Progress in Dredging Machinery (87467 N). William Brown, with abstract of discussion. Ills. 72 pp. Instn C E, Pro—Jan. 9, 1917. The "cutter," "drag," and "moored" types, and dipper dredges.

Dublin

A Note on Some Recent Improvements in the Graving Dock and Ship-repairing Facilities in the Port of Dublin (87519 N). John W. Griffith. Ills. 25 pp. Instn C E Ireland, Trans—Vol. XLIII, 1918.

Flood Embankment

The Effect of Flood Embankments on the River Levels in the Irrawaddy Delta (87473 N). Bernhard Martin Samuelson. (Abridged.) Map. 9 pp. Instn C E, Pro—Paper No. 4171.

French Ports

Les Ports Français Durant La Guerre (87708 B). A. Pawlowski. Ills. 3100 w. Génie Civil—June 1, 1918. Sousse and Sfax, ports of Tunis. Harbor facilities and improvements, commerce before and during the war, etc.

Italy

Via D'Acqua di Grande Navigazione fra Milano ed il Lago di Como (87703 B). Ills. 4200 w. Monitore Tecnico—Apr. 20-30. Projected canal forming an inland waterway from Milan to Lake Como.

Levees

Levee Construction in North Texas with Draglines (87623). O. W. Finley. Ills. 1050 w. Eng & Con—July 17, 1918. Details of levee work and land reclamation.

Monongahela

Monongahela River Navigation (87555 B). H. W. Stickle, with discussion. Ills. 33 pp. Engrs' Soc W Penn, Pro—April, 1918. Results obtained by canalization; the business of the river; improvements needed, etc.

Rhone

Le Rhône (87733 B). A. Koehler. Ills. 2300 w. La Nature—June 1, 1918. Industrial migration in Southern France due to power development of River Rhone. River improvement projects.

Sweden

Malmo's Future Free Port (87525). 2500 w. Naut Gaz—July 13, 1918. Contemplated improvements to and equipment of. Industrial Harbor, in Sweden.

Suez Canal

Suez Canal Company's Report for 1917 (87362). 1200 w. Naut Gaz—July 6, 1918. Extract from the annual report, showing the effect of the war.

Valparaiso

Deep-Water Moorings in Valparaiso Bay (87476 N). Henry Charles Anstey. Ills. 10 pp. Instn C .E, Pro—Paper No. 4216. Explains conditions and the problem of moorings in the bay.

MARINE AND NAVAL ENGINEERING

Barge Canal

See same heading under CIVIL ENGINEERING, *Waterways and Harbors.*

British Navy

Our Merchant Navy—The War and After (87401 A). 5000 w. Engr—June 14, 1918. The importance of the mercantile marine as a part of the British navy; shipping and shipbuilding before the war; the present and future.

Capacity

Passengers In Ships (87725). 1000 w. Times Engng Supp—June, 1918. Cost of passenger transportation as compared with cargo.

Concrete Ships

Construction of Concrete Ships (87463 N). 56 pp. Gov Print Off, Doc. 239—June 7, 1918. Letters and reports submitted on the cost, plant and advantages.

Construction Problems Many in Building Concrete Ships (87505). 2500 w. Eng News-Rec—July 11, 1918. How the Shipping Board is preparing for the new government construction as outlined by Rudolph J. Wig and S. C. Hollister, in paper before Am. Concrete Inst.

Government Attitude on the Concrete Ship (87318 A). Waldon Fawcett. 1200 w. Int Mar Eng—July, 1918. Open minded but waiting for results.

Government Designs and Builds 3500-Ton Concrete Ships (87313). Ills. 1500 w. Eng News-Rec—July 4, 1918. Details of vessels under construction.

The Big Concrete Ship Not Unreasonable (87319 A). J. F. Springer. 5000 w. Int Mar Eng—July, 1918. Views of an advocate of reinforced-concrete vessels.

Diesel Engines

See same heading under MECHANICAL ENGINEERING, *Combustion Motors.*

Great Britain

Britain's Ship Industry (87645). 9500 w. Naut Gaz—July 20, 1918. Recommendations of committee of Board of Trade for rehabilitation after the war.

Joints

Oil- and Water-tight Joints in Ships' Hulls (87323 A). Evers Burtner. Ills. 2200 w. Int Mar Eng—July, 1918. Methods of securing tight joints under different conditions.

Merchant Marine

American Merchant Marine Will Total 25,000,000 Tons in 1920 (87317 A). Edward N. Hurley. 3000 w. Int Mar Eng—July, 1918. From an address at University of Notre Dame, South Bend, Ind., on June 10.

Sale and Purchase of British and Foreign Trading Vessels During 1917 (87405 A). T. Sington. 2500 w. Ir & Cl Trds Rev—May 10, 1918. Steamers and sailing vessels that have changed hands.

Navigation

An Interpolating Instrument to Expedite the Use of Aquino's Tables in Navigation (87496 A). Alexander Forbes. Ills. 2500 w. U S Nav Inst, Pro—June, 1918. Describes instrument based on the principle of similar triangles.

A New Method of Using Altitude and Azimuth Tables to Obtain a Ship's Position at Sea (87495 A). Abner B. Clements. 3000 w. U S Nav Inst, Pro —June, 1918. Explanation.

Riveting

Riveting Records in Shipbuildnig (87343 A). 1200 w. Engng—May 31, 1918. Records with power riveting and factors influencing performance.

Salvage

Merchant Vessel Salvage (87724). 2000 w. Times Engng Supp—June, 1918. Work accomplished by British Admiralty in salving valuable cargoes.

Deep Water Salvage (87644). Ills. 1200 w. Naut Gaz—July 20, 1918. Devices for raising vessels from great depths. Possibilities of success at 1,000 feet.

Salvage of Merchant Ships (87551 A). Ills. 2300 w. Engr—June 21, 1918. Gives details of notable pieces of salvage work.

Shipbuilding

Design Steel Ship of Maximum Efficiency of Bridge-Shop Fabrication (87311). Ills. 4000 w. Eng News-Rec —July 4, 1918. The assembly plant at Hog Island; hull parts made in distant shops.

Handling Materials at Hog Island (87189 A). H. Cole Estep. Ills. 1600 w. Mar Rev—July, 1918. Methods.

Hog Island's Ship-Erection Equipment: Four Hundred Tower Derricks for Fifty Ways (87501). Ills. 1800 w. Eng News-Rec—July 11, 1918. Ample equipment provided for this large yard.

More Steel, More Ships Are Assured (87190 A). Charles M. Schwab. 1200 w. Mar Rev—July, 1918. Address at meeting of the Iron & Steel Inst.

Rapidly Growing Ship Production Speeded by the Emergency Fleet Corporation (87315). 3500 w. Eng News-Rec—July 4, 1918. Shipbuilding programme and launchings.

World's Ship Output Now Exceeds Losses (87361). Bainbridge Colby. 2500 w. Naut Gaz—July 6, 1918. Reviews the work of the United States Shipping Board.

The Foundation Company—Shipbuilders (87320 A). Ills. 2000 w. Int Mar Eng—July, 1918. Recent development in the shipbuilding industry.

Shipping

Post-War Shipping Practices (87226). From the *Compendium*. 1050 w. Naut Gaz—June 29, 1918. Deals with the question of government control, fabricated and concrete ships.

Is Uncle Sam a Good Ship Operator? (87188 A). V. G. Iden. Ills. 2500 w. ·Mar Rev—July, 1918. Analyzes the work the shipping board must do in operating the ships efficiently.

Ship's Piping

Piping Arrangements Aboard Ship (87321 A). Arthur H. Baker. 1000 w Int Mar Eng—July, 1918. Serial, 1st part. Detailed description of the ship's piping system.

Main and Auxiliary Steam Piping (87199 A). Ralph W. Propert. 3000 w. Am Soc Mar Dftn, Jl—April, 1918. Fundamental features of piping systems aboard ships.

Spanish Navy

Spanish Navy Construction (87347 A). Ills. 1500 w. Engr—May 31, 1918. Recent development in Spanish shipbuilding.

Standard Oil

Standard Oil's Losses (87642). 2000 w. Naut Gaz—July 20, 1918. The tankers have many battles with German U-boats.

MINING AND METALLURGY

Copper

Copper (87454). Ills. 100 pp. U S Bur Stds, No. 73—June 25, 1918. Deals primarily with the physical properties of pure and of commercial grades of copper.

Cunningham Pass District, Arizona (87420). W. Tayote. Maps. 1500 w. Min & Sci Pr—July 6, 1918. A district attracting attention for its high-grade copper ore.

Copper Determination

Iodide Copper Method With Sodium Fluoride (87250). A. L. Reese. 1000 w. Eng & Min Jl—June 29, 1918. Details of the process.

Zinc

Research Preparedness in the Zinc Industry (87246 A). Parker C. Choate. 3000 w. Chem & Met Eng—July 1, 1918. Phases of zinc metallurgy on which research is desirable.

COAL AND COKE

Brick Works

The Wrenthorpe Brick Works (87754 A). Ills. 2500 w. Ir & Cl Trds Rev—June 28, 1918. Details of works illustrating a practical method of turning colliery refuse to commercial account.

Coal

The Micro-Chemical Examination of Coal (87356 A). 4500 w. Colly Gdn—June 14, 1918. Reviews paper by J. Lomax on research work, methods, results, etc.

Coal Conservation

Coal Conservation in New England (87737 A). Dr. Ira N. Hollis. 6000 w. Ind Man—August, 1918. Outline of the fuel situation showing how methods of economy and conservation may offset a 20% shortage.

Coal Restrictions

Coal Consumption Restrictions Government Proposes to Enforce (87480). 1200 w. Mfrs Rec—July 11, 1918. Discusses the programme for saving fuel.

Coal Slack

Flow of Air Through Small Coal and Other Broken Material (87358 A). J. T. Storrow. Tables. 1000 w. Colly Gdn—June 14, 1918. Report to Instn. of Min. Engrs. Experiments to ascertain the influence of size on the rate of flow under different conditions.

Coal Storage

Storing Coal at Moonheart, Illinois (87571). Ills. 1800 w. Power—July 16, 1918. Portable conveyors tied in with the coal-handling equipment. Methods and cost.

Coal Trade

The Coal Trade After the War (87755 A). 2500 w. Ir & Cl Trds Rev—June 28, 1918. Serial, 1st part. Report of British Board of Trade Committee.

Coke

The Importance of Coke Hardness (87380 N). G. D. Cochrane. Ills. 12 pp. Ir & St Inst—May, 1918. Its importance in regard to consumption in the blast furnace.

Combustion

Spontaneous Combustion (87613 D). M. W. Franklin. 10 pp. Am Soc Ht & Vt Engrs, Jl—July, 1918. Abstract. A study of the conditions for spontaneous combustion, and its prevention. With notes on spontaneous combustion of coal, by the U. S. Bureau of Mines.

Dye Industry

The British Dye Industry (87350 A). 1800 w. Engr—June 7, 1918. Account of recent development at Huddersfield, Eng.

Fuel

Maximum Fuel Production With Minimum Fuel Waste (87741 A). David Moffat Myers. 900 w. Ind Man—Aug., 1918. Efforts to stimulate production and eliminate avoidable wastes in view of coal shortage.

The Present Fuel Situation (87781 A). F. F. Uehling. 3000 w. Ind Man—Aug., 1918. Dependence of production upon fuel supply. Need of more intelligent use of recording devices.

Fuel Economy (87445 A). A. P. Wells, with discussion. 5500 w. S & S W Ry Cb, Pro—May, 1918. Outlines help possible in saving fuel by those handling it.

The Economical Use of Fuel (87303 A). Ills. 57 pp. A S M E, Jl—July, 1918. A symposium contributed to the Worcester meeting, June, 1918, on the conservation of fuel.

Fuel Order

New Coal and Lighting Order (87769 A). 8500 w. Colly Gdn—July 5, 1918. The "Household Fuel and Lighting Order, 1918," applying to England and Wales, restricting the consumption of coal, gas and electricity for domestic purposes.

Fuel Resources

Methods for More Efficiently Utilizing Our Fuel Resources (87448 A). E. B. Elliott. Map & Ills. 2500 w. Gen Elec Rev—July, 1918. Aims to show that the production of coke by the beehive oven is wasteful and that the by-product oven process is efficient.

Ownership

The Colliery Manager and State Ownership (87411 A). F. McAvoy. Read before Assn. of Colly. Mgrs. 3500 w. Ir & Cl Trds Rev—June 7, 1918. The control of the mining industry in the British Isles.

Pillars

Extracting Coal Pillars from Fiery Seams (87768 A). R. H. Husband. Ills. 4000 w. Colly Gdn—July 5, 1918. From paper before Min. & Geol. Inst. of India. Sources of danger, preventive measures, packing, etc.

Powdered Coal

The Possibilities of Powdered Coal as Shown by Its Combustion Characteristics (87248 A). W. G. Wilcox. 7000 w. Chem & Met Eng—July 1, 1918. Shown to be efficient and flexible in meeting various demands.

Pulverized Coal

Use of Pulverized Coal at the Bunker Hill and Sullivan Smelting and Refining Plant (87665 A). C. T. Rice. Ills. 1800 w. Eng & Min Jl—July 20, 1918. Methods adopted to pulverize coal for use in smelting and boiler works, and the control and distribution by the Holbeck system.

Queensland

Coal Near Wondai (87492 N). Lionel C. Ball. Ills. 2500 w. Qnsd Gov Min Jl—May, 1918. With notes on a discovery of cobalt in the Burnett district, geological features and description of coal.

Sampling

The Commercial Sampling and Analysis of Coal, Coke, and By-Products (87490 N). Ills. 1300 w. Chem Eng & Min Rev—May, 1918. Comments on methods of the U. S. Steel Corporation.

See also Powdered Fuel, under MECHANICAL ENGINEERING, *Steam Engineering*.

GEOLOGY

Apexes

Apexes and Anticlines (87536). Robert M. Searls. Ills. 1700 w. Min & Sci Pr—July 13, 1918. Decision of the U. S. Supreme Court in the case of Jim Butler Tonopah Mining Co. v. West End Consolidated Mining Co.

Earth Structure

The Growth of Knowledge of Earth Structure (87603 D). Joseph Barrell. 38 pp. Am Jl Sci—July, 1918. Synopsis of progress made during the last century.

Geological Surveys

A Century of Government Geological Surveys (87604 D). George Otis Smith. 22 pp. Am Jl Sci—July, 1918. Reviews the history of the work accomplished.

Historical Geology

A Century of Geology.—The Progress of Historical Geology in North America (87601 D). Charles Schuchert. 69 pp. Am Jl Sci—July, 1918. Synopsis of the more important steps in the progress from 1818 to 1918.

Ironstones

The Jurassic Ironstones of the United Kingdom — Economically Considered (87381 N). F. H. Hatch. Ills. 45 pp. Ir & St Inst—May, 1918. Particulars regarding their distribution, composition, and output.

Land Forms

A Century of Geology—Steps of Progress in the Interpretation of Land Forms (87602 D). Herbert E. Gregory, with bibliography. 29 pp. Am Jl Sci—July, 1918. Traces the fluctuation in the development of fact and theory as related to valleys and glacial features.

Mineralogy

The Growth of Mineralogy From 1818 to 1918 (87605 D). William E. Ford. 15 pp. Am Jl Sci—July, 1918. Review of progress.

IRON AND STEEL

Blast Furnaces

Blast-Furnace Bears (87384 N). J. E. Stead. Ills. 41 pp. Ir & St Inst—May, 1918. Study of the variable characters of bears, their constituents and their genesis.

Entire Blast Furnace Plant Salvaged (87791 A). Ills. 1000 w. Iron Age—July 25, 1918. Removal of a Midland, Ont., stack and its re-erection at Sault Ste. Marie.

Inquiry on Blast-Furnace Practice in the United Kingdom (87379 N). 18 pp. Ir & St Inst—May, 1918. Questions and summaries of replies from about 26 firms, on the effect of condition of raw materials, and on gas-cleaning.

Modern German Blast-Furnace Plant (87416 A). Ills. 1000 w. Ir & Cl Trds Rev—June 21, 1918. Description given by Max [illegible] of No. 1 Plant at Oberhausen, as it will be when remodeled.

Canada

The Iron Resources of Canada (875[illegible] A). 5000 w. Engng—June 21, 1918. Reviews a recent report issued by the Canada Dept of Mines.

Cobalt Steel

The Determination of Cobalt and Nickel in Cobalt Steel (87392 N). W. R. Schoeller and A. R. Powell. 5 pp. Ir & St Inst—May, 1918. Description of method.

Copper Tuyeres

Copper Tuyeres for Blast-Furnaces (87383 N). A. K. Reese. Ills. 6 pp. Ir & St Inst—May; 1918. Advantageous features as compared with cast iron tuyeres.

Electric Steel

Electric Steel and the Forging Industry (87522 N). Arthur V. Farr. From paper before Am. Drop Forge Assn. Ills. 1800 w. Iron Age—July 11, 1918. Steel from cold or hot metal.

Triplex Process of Making Electric Steel (87245 A). Theodore W. Robinson. Excerpt from paper before Am. Ir. & St. Inst. Ills. 3500 w. Chem & Met Eng—July 1, 1918. Development at South Chicago of the world's largest electric steel plant.

Ferromanganese

Liquid Ferromanganese in Steel Making (87793 A). E. C. Hummel. 1500 w. Iron Age—July 25, 1918. Advantages over using the solid alloy.

France

Iron and Coal in France After the War (87409 A). 2500 w. Ir & Cl Trds Rev—May 24, 1918. Serial, 1st part. Opinions in regard to the workable deposits, and the value of mines taken by Germany.

Fuel

Fuel Economy in Blast Furnaces (87382 N). T. C. Hutchinson. Ills. 14 pp. Ir & St Inst—May, 1918. Conditions in blast-furnaces that secure long life of furnace lining, and the resulting fuel economy.

India

Technical Aspects of the Establishment of the Heavy Steel Industry in India, with Results of Some Researches Connected Therewith (87385 N). Andrew McWilliam. 20 pp. Ir & St Inst—May, 1918. Historical account.

Ingots

Defects in Steel Ingots (87386 N). J. N. Kilby. Ills. 24 pp. Ir & St Inst—May, 1918. Previous conclusions upon influence of casting, with observations and results. Some reference to the electric process.

Production of Sound Steel by Lateral Compression of the Top Portion of the Ingot (87348 A). Benjamin Talbot. Ills. 1200 w. Read before Iron & Steel Inst. Engr—May 31, 1918. Describes an apparatus for compressing the top part of the ingot after removal from the mould.

Iron Ore

British and Colonial Iron Ore Supplies (87765 A). 1200 w. Engng—June 28, 1918. Information concerning reserves and possibilities of Colonial supplies.

Metallilc Structure

See same heading under Electro-Physics.

Plate Mill

Youngstown Sheet & Tube Tandem Plate Mill (87195 A). Ills. 1500 w. Iron Age—June 27, 1918. [illegible] slab-heating furnaces and new type of plate turnovers, with other features of interest.

Production

Cost of Production of Iron and Steel in Canada and the United States (87770 A). Corbett F. Whitton, with discussion. From a paper before the Can. Min. Inst. 3000 w. Ir & Cl Trds Rev—July 5, 1918. Tabulated comparisons of cost and selling prices, with explanatory notes.

Steel Output

Chemist's Part in Speeding Up Steel Output (87193 A). A. F. Macfarland. Ills. 2500 w. Iron Age—June 27, 1918. Outlines methods for rapid and efficient preliminary analysis.

Steel

Damascene Steel (87391 N). N. Belaiew. Ills. 21 pp. Ir & St Inst—May, 1918. History; methods of producing this steel; report of investigations, etc.

La Macrostructure De L'Acier (87706 C + D). A. Portevin and V. Bernard. Ills. 3500 w. Revue De Métallurgie—May-June, 1918. A study of the "macrostructure" of steel by means of the new Stead-Le Chatelier reagent.

Iron, Carbon, and Phosphorus (87390 N). J. E. Stead. Ills. 24 pp. Ir & St Inst—May, 1918. The effect of introducing carbon by cementation into homogeneous solid solutions of iron and phosphorus; and the temperature ranges in which free phosphide of iron passes in and out of solid solution in iron.

The Effects of Cold-Working on the Elastic Properties of Steel (87389 N). J. A. van den Broek. Ills. 40 pp. Ir & St Inst—May, 1918. A study as to the effects in tension, compression and torsion.

Steel Plant

Mark Mfg. Co. and Iroquois Iron Co. Merge (87520 A). Ills. 1200 w. Iron Age—July 11, 1918. Consolidation creates a new self-contained steel plant.

Trade

Iron and Steel Trade After the War (87413 A). 7000 w. Ir & Cl Trds Rev—June 14, 1918. Serial, 1st part. Report of Board of Trade Committee.

MINE OPERATION

Blackdamp

The Origin of Blackdamp (87415 A). J. Ivon Graham. Abstract of paper before Instn. of Min. Engrs. 1600 w. Ir & Cl Trds Rev—June 14. 1918. Possible sources of the carbon dioxide and nitrogen of blackdamp.

Blasting

Blasting Methods at Ajo (87537). S. U. Champe. Ills. 1200 w. Min & Sci Pr—July 13, 1918. Excavation of hard copper ore at the mines of the New Cornelia company. Methods.

Hoisting

Hoisting by Stages From Deep Mines (87539). R. A. Balzari. Ills. 1300 w. Min & Sci Pr—July 13, 1918. Underground hoist used at Argonaut mine, California, is described.

Colliery Cable Suggestions ((87756 A). A. R. Davies. Ills. 2000 w. Ir & Cl Trds Rev—June 28, 1918. Read before Min. Elec. Engrs. Types and method of erection are considered.

Overhead Kolpe Winding Plant at Plenmeller Colliery, Haltwhistle (87354 A). George Raw. Ills. 5000 w. Colly Gdn—June 7, 1918. From paper before N. of Eng. Inst. of Min. & Mech. Engrs. Description of plant, winding rope, rope slip, etc.

Mine Fire

Mine Fire at Utah-Apex Mine (87494 A). V. S. Rood and J. A. Norden. Ills. 3000 w. Sfty Eng—June, 1918. Conditions during and after the fire.

Mine Ventilation

See same heading under Mechanical Engineering, *Heating and Cooling*.

Mining Machines

Notes on Operating Mining Machines (87410 A). M. Dempster. Ills. 3000 w. Ir & Cl Trds Rev—June 7, 1918. Read before E. of Scot. Br. of Assn. of Min. Elec. Engrs. The actual work of operating coal-cutters.

Shafts

Notes on Shaft Relining With Concrete (87422). G. G. Stonemark. 3000 w. Eng & Min Jl—July 6, 1918. Methods used in relining two shafts on the Mesabi range.

Repairing a Small Circular Shaft (87357 A). S. Chambers. Ills. 2500 w. Colly Gdn—June 14, 1918. From paper read before the Min. Inst. of Scotland. Describes work at a colliery near Bristol

MINES AND DISTRICTS

Portugal

The Mineral Industry of Portugal (87528). Frederick W. Foote and Rastus S. Ransom, Jr. Ills. & Map. 5000 w. Eng & Min Jl—July 13, 1918. Résumé of mineral activities, with some production figures and details of working conditions.

Queensland

Queensland Mines Inspection (87788 N). C. F. V. Jackson. 3500 w. Qnsd Gov Min Jl—June, 1918. Extracts from mining engineer's report for 1917. Deals with labor, wages, accidents, ventilation.

The Mining Industry of Queensland (87787 N). A. J. Jones. 5500 w. Qnsd Gov Min Jl—June, 1918. Address by the minister for mines on the more important minerals and their development.

Rand

The Survey Office on the Rand (87530). E. M. Weston. 2500 w. Eng & Min Jl—July 13, 1918. Work of the mine surveyor in controlling stoping operations.

MINOR MINERALS

Kiln

The Deadburning of Magnesite and Dolomite (87345 A). E. Steiger. Ills. 600 w. Engng—May 31, 1918. Abstract of paper before the Ceramic Soc. Has reference to the Swiss economic kiln. Author's patent.

Manganese

Valuation of Manganese Ores (87257). 3800 w. Eng & Min Jl—June 29, 1918. Notes from a paper by George T. Holloway, read some years ago before the Instn. of Min. & Met.

Mercury

Mercury Minerals in New Zealand (87488 N). Charles H. Holland. Map. 3000 w. Chem Eng & Min Rev—May, 1918. Describes deposits in several districts.

Potash

Why Not a Potash Recovery Industry in Australia? (87486 A). Ills. 3800 w. Aust Min Stan—May 23, 1918. An account of what has been accomplished in America.

Tungsten

The Production of Quicksilver and Tungsten (87418). Maps. 2800 w. Min & Sci Pr—July 6, 1918. As discussed before the U. S. Tariff Commission at San Francisco. Production and prices.

OIL AND GAS

Gas Industry

The Future of the Gas Industry (87351 A). 2200 w. Engr—June 7, 1918. The type of gas required; flame temperature; diluents; organization for the future.

The Gas Industry (87400 A). Lord Moulton. Presidential address. 5500 w. Engng—June 14, 1918. Response of this industry in furnishing material for war purposes, its capacity for service. Reviews the history of development and the future needs.

Motor Spirit

The Roma Oil Bore (87491 N). W. E. Cameron. Ills. 1500 w. Qnsd Gov Min Jl—May, 1918. Prospects of obtaining motor spirit from the gas.

Oil Deposits

Possible Existence of Deep-seated Oil Deposits on the Gulf Coast (87675 D). Anthony F. Lucas. Ills. 16 pp. A I M E, Bul—July, 1918. Possibility of finding deep-seated oil deposits beneath the salt domes.

Oil Losses

Losses of Crude Oil in Steel and Earthen Storage (87676 D). O. U. Bradley. 4 pp. A I M E, Bul—July, 1918. Losses due to evaporation, sediment, water, and leakage.

"Paraffin Dirt"

An Interpretation of the So-called Paraffin Dirt of the Gulf Coast Oil Fields (87678 D). 6 pp. A I M E, Bul—July, 1918. Discussion of Albert D. Brokaw's paper.

Refining

Petroleum Refining (87483 B). C. W. Stratford, with discussion. Ills. 4500 w. S A E, Jl—July, 1918. Deals with the refining of Pennsylvania petroleum by steam distillation.

ORE DRESSING

Africa

Data on Crushing and Cyaniding in a West African Mill (87529). Paul T. Bruhl. Ills. 2500 w. Eng & Min Jl—July 13, 1918. Results obtained in a Gold Coast Colony mill.

Baghouses

Baghouses for Zinc Oxide (87671 A). John F. Cregan. Ills. 6000 w. Eng & Min Jl—July 20, 1918. Problems in baghouse design and operation.

Concentration

Belt Concentrators and Wet Concentration (87423). Alex. McLaren. 1800 w. Eng & Min Jl—July 6, 1918. Considers the limitations of belt concentrators and riffled tables.

Flotation

Cascade Method of Froth Flotation (87759). W. A. Fahrenwald. Ills. 500 w. Min & Sci Pr—July 20, 1918. New types of apparatus utilizing the principle of agitation by fall of pulp.

Notes on Flotation (87600 N). R. W. Diamond. 2200 w. Can Min Inst, Bul—July, 1918. Deals only with bulk flotation—the concentration of all sulphides present in an ore into the froth product.

Fumes

New Fume-Treatment Plant at Anaconda (87275). D. M. Brown. Ills. 1800 w. Min & Sci Pr—June 29, 1918. Smoke-treatment plant, estimated to cost $2,000,000, including the largest chimney in the world, now under construction at Washoe smelter.

Ore Pulps

The Automatic Separation of Solution from Solids in the Hydrometallurgical Treatment of Ore Pulps (87677 D). Bernard Macdonald. Ills. 4 pp. A I M E, Bul—July, 1918. Explains method, giving results.

Refining

The Maintenance of High Ampere Efficiency in Electrolytic Copper Refining (87666 A). M. H. Merriss and M. A. Mosher. Ills. 4000 w. Eng & Min Jl—July 20, 1918. Practical work of maintaining efficiency by organization and suitable apparatus.

Smeltery

Ideal Layout for Silver-Lead Smeltery (87670 A). Guy C. Riddell. Ills. 6000 w. Eng & Min Jl—July 20, 1918. Methods of lead smelting practice in the United States and Australia, with plans of an ideal plant.

Smelting

Mechanical Scotch-Hearth Smelting (87667 A). William E. Newnam. Ills. 1200 w. Eng & Min Jl—July 20, 1918. Substitution of mechanical for hand-operated Scotch hearths, describing installations.

Notes on Recent Metallurgical Progress (87672 A). E. P. Mathewson. Ills. 8000 w. Eng & Min Jl—July 20, 1918. Recent improvements at some of the great smelteries of the United States and Canada.

Safety Appliances in Smelteries and Refineries (87668 A). George M. Douglass. Ills. 3000 w. Eng & Min Jl—July 20, 1918. Describes devices to prevent accidents.

PRECIOUS METALLURGY

Australia

Gold Mining in Western Australia (87771 N). Thomas Butement. Ills. 2500 w. Chem Eng & Min Rev—June 5, 1918. Serial, 1st part. The present position and outlook of the Kalgoorlie mines.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Collision

Rear End Collision at Ivanhoe, Ind., on Michigan Central (87223). Ills. 1000 w. Ry Age—June 28, 1918. Account of collision with circus train, killing 78 and injuring 120.

Signals

Interesting Signal Installation on Central of Georgia (87371). W. D. Cloud. Ills. 2500 w. Ry Sig Engr—July, 1918. Methods employed to reduce labor on the line.

The Use of Signals for Train Operation (87370). Henry M. Sperry. Ills. 5000 w. Ry Sig Engr—July, 1918. How power-operated three-position train order signals on the Erie in connection with automatics helps train movements.

MOTIVE POWER AND EQUIPMENT

Air Brakes

Actual Value of Improved Brake Equipments for Electric Service (87432 A). Walter V. Turner. 1800 w. Ry & Loc Eng—July, 1918. Points out the potential value of improved brakes.

Freight Brake Maintenance ([illegible] A). [illegible]. 4000 w. Ry Mech Engr—July, 1918. Importance of efficient brakes in transportation problems.

Ambulance Trains

Two Ambulance Trains for the United States Army ([illegible]). Ills. 700 w. Ry Age—July 12, 1918. Trains built by the Great Western of England.

Axles

Heat Treatment of Axles (87440 A). Dwight D. Miller. 2200 w. Ry Mech Engr—July, 1918. Scientific heat treatment of locomotive and car axles.

Cars

70-Ton Side Dump Hopper Cars Built by E. J. & E. (87221). Ills. 1000 w. Ry Age—June 28, 1918. Center sill is not continuous; the floor members are arranged to withstand buffing stresses.

Steel Frame Refrigerator Cars (87436 A). E. G. Goodwin. Ills. 2500 w. Ry Mech Engr—July, 1918. Norfolk and Western design has bunched insulation, insulated bulkheads and conduit floor racks.

Dynamometer Tests

Dynamometer Tests and Their Relation to Locomotive Efficiency (87446 A). C. M. Darden. Ills. 2500 w. S & S W Ry Cb, Pro—May, 1918. Considers benefits gained by dynamometer test.

Electric Locomotives

Locomotives A Courant Monophasé (87713 B). H. Studer. Ills. 3100 w. Génie Civil—June 15, 1918. New types of single-phase, A C locomotives built at Oerlikon Works for Swiss Railways.

Electrification

Electrification of the New York Connecting Railroad and Hell Gate Bridge (87428 A). Ills. 1000 w. Ry & Loc Eng—July, 1918. Detailed description of the single phase, overhead catenary system.

Feed Water

Feed Water Heaters (87376). J. Snowden Bell. Ills. 2000 w. Ry Rev—July 6, 1918. Basic principles on which feed water heaters for locomotive use should be constructed.

Fuel Economy

How Can Coal be Saved on the Engine (87631). 1500 w. Ry Age—July 19, 1918. Suggestion to aid in fuel economy.

Locomotive Maintenance

European and American Practice (87431 A). 1200 w. Ry & Loc Eng—July, 1918. Explains systems of design and maintenance.

Locomotives

Features and Functions of Goods Locomotives (87493 N). William Prior Hales. Ills. 2000 w. Comwlh Engr—June, 1918. Types in use on railways of several states of Australia.

First of U. S. Standard Locomotives Completed (87630). Ills. 1000 w. Ry Age—July 19, 1918. Light Mikado type for service on the B. & O.

Mallet Articulated Locomotives for the Baltimore & Ohio Railroad (87430). Ills. 1200 w. Ry & Loc Eng—July, 1918. Detailed description.

Mikado Type of Locomotive for the United States Government (87692). Ills. 700 w. Ry Rev—July 20, 1918. Represents best conservative thought in American locomotive design.

Norfolk & Western 267-Ton Mallet Locomotive (87506). H. W. Reynolds. Ills. 2000 w. Ry Age—July 12, 1918. Details of design.

To avoid error, please order by title and number only.

Pacific and Mikado Type Locomotives, C. B. & Q. R. R. (87375). Ills. 1200 w. Ry Rev—July 6, 1918. Four designs, constructed with a large number of interchangeable parts.

Tests with 2-10-2 Locomotive on the Union Pacific (87224). Ills. 1000 w. Ry Age—June 28, 1918. In service six months with very satisfactory results. Heavy freight locomotive.

Lubrication

Difficulties of Locomotive Lubrication (87336 A). 1800 w. Mech Wld—May 31, 1918. The problem of valve and cylinder lubrication is discussed.

M. C. B. Assn.

A Statement of the Purpose of the M. C. B. Association (87435 A). Joseph W. Taylor. 2000 w. Ry Mech Engr—July, 1918. Reasons and objects for its formation, and information relating to developments.

Military Lines

Chemins De Fer A Voie Étroite (87714 B). E. Lemaire. Ills. 7700 w. Génie Civil—June 22, 1918. Locomotives and cars for military lines of 23.6 in. gage behind the Allies fighting front. Track material, gun trucks, etc.

Superheaters

Installation and Repair of Superheater Dampers (87429 A). Ills. 1000 w. Ry & Loc Eng—July, 1918. Explains methods of maintaining proper adjustment of the parts.

PERMANENT WAY AND BUILDINGS

Light Railroads

Light Railroads at the Front (87693). 1500 w. Ry Rev—July 20, 1918. Brief account of the light railroads operating in France and their usefulness.

Maintenance

Maintenance Work Is Being Seriously Delayed (87507). 3500 w. Ry Age—July 12, 1918. Shortages of labor, rail, and ties.

Repair Shops

Reclamation on the Southern Pacific (87434 A). Frank A. Stanley. Ills. [illegible] w. Ry Mech Engr—July, 1918. Serial, 1st part. Extensive salvage work.

Chilean Railroad Shops of American Design (87615 A). Walter W. Nowak. Ills. 2500 w. Iron Age—July 18, 1918. Represent the best American practice.

Terminals

New York Central Opens Cleveland Freight Terminal (87629). Ills. 3500 w. Ry Age—July 19, 1918. Details of L. C. L. station costing more than $4,000,000.

Tracks

Completing the Double Track on the Union Pacific (87220). Ills. 3000 w. Ry Age—June 28, 1918. The heavy traffic made necessary the construction of 96 miles of second main line during 1917. Details of the work.

ROADS AND PROJECTS

China and Japan

The Chinese and Japanese Railways Compared (87222). Frank Rhea. Ills. 2000 w. Ry Age—June 28, 1918. Japan's lines have a semi-military organization. Chinese have not control of their railways.

Russia

Russian Railroads as They Are (87482). Joseph E. Greiner. 1500 w. Mfrs Rec—July 11, 1918. Detailed description.

The American Railway Commission and Russian Railroads (87620). J. E. Greiner. 2000 w. Eng & Con—July 17, 1918. Abstract of address before Engrs' Cb. of Baltimore describing conditions, and giving chief recommendations.

TRAFFIC

Freight

Report on Proposed Store Door Freight Delivery in New York City (87535). 5000 w. Ry Rev—July 13, 1918. Report of James S. Harlan recommending the discontinuance of free time in removing less than carload freight.

United Kingdom

Coal and Mineral Traffic on the Railways of the United Kingdom (87553 A). H. Kelway-Bamber. 2500 w. Engr—June 21, 1918. Calls attention to the need of using wagons of the largest possible carrying capacity.

STREET AND ELECTRIC RAILWAYS

Australia

The New South Wales Government Tramways (87632). Ills. 1200 w. Elec Ry Jl—July 6, 1918. Brief account of Australia's greatest electric railway system.

Coasting

Saving That "Extra Shovelful of Coal" by Increased Coasting (87634). Harry C. Kendall. 2500 w. Elec Ry Jl—July 13, 1918. Experiences and results obtained in Denver, by use of coasting recorders.

Economical Maintenance

Money-Saving Factors in the Maintenance of Special Work (87659). R. C. Cram. Ills. 4000 w. Elec Ry Jl—July 20, 1918. Requirements for economic maintenance.

Overhead Structures

Providing Strength and Attractiveness in Special Overhead Supports (87656). Charles R. Harte. Ills. 3000 w. Elec Ry Jl—July 20, 1918. Considers overhead bridges and other special structures.

Peak-Load Power

International Railway Installs Steam Turbine in Unique Location (87633). Ills. 1500 w. Elec Ry Jl—July 13, 1918. A 5500-kw. second-hand turbine installed for a peak-load power supply.

Rates

Increased Revenue to Offset Higher Wages (87254). Thomas N. McCarter. 1800 w. Elec Ry Jl—June 29, 1918. Considers the power of the federal government to raise rates.

Raise Rates to Permit Higher Wages (87253). Also editorial. 8000 w. Elec Ry Jl—June 29, 1918. The effect of the financial condition of electric railways upon determination of rates by the War Labor Board. Opinions of rate experts on the matter.

What Is a Fair Return in War Time? (87635). John Bauer. 2500 w. Elec Ry Jl—July 13, 1918. Rates on new investment must be based on market conditions.

Speed-Time

Effect of Grades and Curves in Plotting Speed-Time Graphs (87657). C. W. Squier. 2000 w. Elec Ry Jl—July 20, 1918. Calculations and methods described.

BOOK NOTICE

BUSINESS LAW. By Thomas Conyngton, with the collaboration of Elizabeth A Smart. Size 6x9, 536 pp. Price $4.00 New York. The Ronald Press Company.

This is a very concise yet comprehensive course of reading for the average man or woman on the subject of business law. It endeavors to show the evolution of law and its application in many of the usual occurrences in business life. Naturally in a work of this kind there is much that must be omitted for lack of space, but there is one brief chapter on criminal law which may serve to clear up the general impression of the matter in the minds of many people. Contracts is a topic that is very thoroughly treated, as well as the question of partnerships and new corporations; property rights particularly as they concern husband and wife are defined both in relation to personal and real property. There are some excellent suggestions on the question of making a will and the variety of statutes in the different states is mentioned in connection with the necessity for a sufficient number of witnesses to the execution of such a document. In this connection also the responsibility of trustees and other persons to whom the care and management of property of any kind may be entrusted, is very well, although briefly stated. The latter part of the book is devoted to specimen forms such as contracts for sale of property, bills of sale, powers of attorney, appointments of agents, etc. And there are, as before mentioned, some good suggestions on the simplest and most direct forms for the organization of partnerships and incorporated companies. There is a very complete index, which will no doubt assist the reader in using the work as a reference book. The author uses a clear style, free so far as is possible from technical or legal terms except where required thus enabling him to emphasize more strongly the particular topic that he is treating.

On the whole, the book should attract a wide circle of readers, not only the business man and average reader but the student who contemplates making an extended study of the law as his life work.

INDUSTRIAL MANAGEMENT
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Cost Accounting to Aid Production—I

Application of Scientific Management Principles

By G. Charter Harrison

The author boldly asserts that cost accounting methods are today in as retarded a state of development as was manufacturing previous to the investigations and labors of Frederick W. Taylor. *He gives clear reasons for this statement, and then shows how the great principles of industrial management can and should be applied in cost accounting, for the cost system and all those who operate it should to the greatest possible extent help, not hinder, production.*

Mr. G. Charter Harrison *was born and educated in England and passed eighth in order of merit in the final examination of the Institute of Chartered Accountants in England and Wales. For eight years, up to October, 1916, he was employed by Price, Waterhouse & Company in various capacities; during the latter part of this period as manager of the system division of that firm. From January, 1909, to February, 1911, he was comptroller for the Russell, Burdsall & Ward Bolt & Nut Company. At the latter date he returned to Price, Waterhouse & Company to take up the managership of the system division. In November, 1916, he entered into a partnership with the principals of Baker, Sutton & Company, London, England, chartered accountants under the firm name of Baker, Sutton & Harrison. This firm practiced as industrial engineers and chartered accountants. Owing to conditions brought on by the war that firm was dissolved in May, 1918. Mr. Harrison took over the business and continued it under his own name, retaining the agency of Baker, Sutton & Company of London.*

SHOULD a manufacturer be told by a competent adviser that one of his machines performing an important operation was grossly defective in design and while expensive to operate was turning out a relatively low production of a poor grade of product, he would not be satisfied until he had learned full details of where the trouble was and had taken the necessary steps to correct it.

One of the most important and expensive machines of the average manufacturer, however, is in just the condition indicated—it is costing more, often far more than it should, to produce very much less than he is entitled to expect from it.

The machine referred to is the cost system the mechanism for producing vital information relative to the operation of the business. Curiously enough, while all other branches of industrial management have made marked progress in the last few years, cost accounting methods in general have made no material advance.

It would be futile to estimate the total loss involved in inefficient methods of cost accounting, but it is probable that the average cost system, taking into account all factors, is not more than 50 per cent. efficient, so that the annual loss from this cause may well be regarded as a matter of considerable importance. If the same economic loss involved in inefficient methods of cost accounting were found to result from defective technical practice, a large proportion of the engineering profession would undoubtedly be exercised in finding some means of eliminating this unnecessary tax upon industry.

The continuance of this condition of inefficiency has apparently been due, in the main, to the fact that the manufacturer has not recognized its existence and though in some cases he has realized in a vague

It is a source of wonderment that accountants and engineers have not followed more closely the practice of machine design in drawing plans of operation for systems of manufacturing records and for clerical processes, for the operation of these things is very similar to that of a machine that utilizes mechanical forces. In no other way than by drawing a detailed diagram—a working drawing—can the complex relationships involved in the various forms, records and individual responsibilities be clearly shown.

way that he was spending a lot of money for the information his cost system has furnished, he has accepted the assurance of his cost accountant that the methods adopted conformed to the commonly accepted standards. A manufacturing business cannot be operated safely without some information relative to costs. This fact is generally realized by manufacturers and the existing methods have doubtless been retained in many cases on the by no means safe assumption that any cost system is better than none at all.

Professional accountants, who should obviously be the leaders in the development of cost accounting methods generally, have failed in a marked degree to read the "writing on the wall," and in spite of the fundamental changes in manufacturing methods introduced in recent years have made few contributions of importance toward the revision of cost accounting methods to conform to these industrial developments.

A really valuable and original contribution to the literature of cost accounting, however, is presented in Mr. Benjamin A. Franklin's "Cost Reports for Executives." Mr. Franklin is apparently one of the few accountants who is able to regard cost problems from the standpoint of the manufacturing executive rather from that of the cost clerk.

As a recent review in a leading accounting journal somewhat plaintively remarks:

> To a reviewer of books on accounting, however, there soon comes a sense of slight weariness so aptly termed in trench-slang as "fed-uppedness" as book after book proves to be an old friend with a new face. He is almost tempted to exclaim with the preacher: "There is nothing new under the sun." In the nature of things connected with an art based upon a few fixed principles this is to be expected. All that one can do is to bear in mind that improvements in accounting methods are always possible but evolve by almost imperceptible degrees.

It is true that there is an endless amount of literature on the subject of cost accounting, but in the main it follows the beaten trail and though some improvements have been made in the methods for distributing burden and in other refinements, it is claimed that the present generally accepted methods of cost accounting are in as retarded a state of development as were those of manufacturing previous to the introduction by Frederick W. Taylor of the idea of scientific management. In this connection reference may be made to a recent book on accounting, written by a recognized leader of the accounting profession, a chapter of which is devoted to the problems of cost accounting, but neither in this nor the rest of the book is any reference made to the important changes in manufacturing methods which have resulted from the adoption of scientific management principles, and to the steps which should be taken to bring cost accounting methods generally into line with these latest developments.

Recognition of Defects and Absurdities of Established Accounting Methods

The engineering profession, however, has very clearly perceived many of the defects and absurdities of the established methods of cost accounting, and in no case have these been better demonstrated than by Mr. Harrington Emerson in his work entitled "Efficiency as a Basis for Operation and Wages." In the numerous volumes on scientific management and cost accounting which have appeared since this book was published it is surprising to find so little information along constructive lines as to the methods to be followed in order to put into practical operation the ideas advanced by Mr. Emerson.

As to whether the efficiency engineer ignored the accounting profession, or called upon it in vain for assistance in solving the accounting problems associated with his work of introducing the principles of scientific management, is a question that the writer is not in a position to answer. In endeavoring, however, to solve these problems without the assistance of skilled accountants, as many engineers have done, they have apparently overlooked the fact that though accounting is an art based upon a few simple principles, the effective application of these principles calls for years of study and practical experience. In fact, when the engineer wanders into the domain of accounting technique he is apt to make costly blunders and present as diverting a spectacle as would the accountant in the field of machine design.

Engineers' Failure to Appreciate Cost Accounting

That engineers do not fully appreciate the fact that cost accounting is a complex science necessitating specialized knowledge for its application is evidenced by their writings. It was a distinct shock to the writer after having spent a number of years of very hard work in developing Mr. Emerson's ideas along accounting lines to find, in re-reading one of his books, the somewhat airy statement that cost accounting can be very simply and easily developed from the cost formula he gives. Another engineering writer even states that:

> The employment of an expert accountant to devise and install a cost system in a manufacturing and repairing plant is an absurdity.

And further that:

> An expert on shop management can learn the simple accounting required in a short time. In fact he cannot be an expert without this knowledge.

The above quotations are somewhat illuminating as illustrating the tendency for an expert in one line to underrate the knowledge and experience required to qualify as an expert in another. The old proverb "a little knowledge is a "dangerous thing" applies to accounting as well as to other things.

That the primary purpose to be aimed at in any system of accounts is extreme simplicity of design is a fallacy that will undoubtedly die hard. A cost accounting system is merely a machine for the production of specialized information and, like any other complicated piece of mechanism, should be judged not so much from the standpoint of simplicity of design as from that of the results obtained from its use and the facility and economy with which it can be operated. To condemn any system of accounting on the sole ground of its complex design would be as absurd as to complain that a Packard automobile is far more elaborate in its design than was Trevethick's steam carriage which astounded and alarmed the pedestrian in 1802. Both represent means of transportation, the earlier machine being absurdly simple in design, but no one would claim that it was a superior article to the later invention. Undoubtedly all possible simplicity in design consistent with efficient operation should be aimed at, but the term is a purely relative one and the question is not so much whether a system is simple or not but whether, taking all factors into consideration, it is as little complex as the conditions warrant.

It is believed that the methods which will be submitted later in these articles will demonstrate that accounting plans must be quite complex in design, though not necessarily difficult in operation, if the multiplicity of results are to be obtained with a minimum of expense and without duplication of effort. The designing of such plans demands a high degree of accounting technique and a fundamental grounding in accounting principles which can only be obtained by years of practical accounting experience which obviously the engineer engrossed in his profession is not often in a position to obtain.

SIMILARITY OF A SYSTEM AND A PROCESS OR MACHINE

The writer has visited a number of plants where extensive reorganization work has been undertaken by efficiency engineers, but in no case which has come to his attention has there been any complete layout of the plan to be followed. A manufacturer, employing the services of an engineer to design a machine to meet some special requirement of his business, would certainly feel entitled to call for complete working drawings of the proposed machine before he approved the spending of possibly several thousand dollars for its construction, particularly so if he were better acquainted with the manufacturing processes involved than the engineer he employed. It would also seem reasonable for a manufacturer, employing the services of efficiency engineers to undertake the introduction of improved methods in his plant, to require similar complete drawings illustrating the results contemplated under the plan and the steps proposed to realize these results. For, though the manufacturer is calling upon outside assistance in the solution of his problems, it is obvious that there must necessarily be many details of the business with which he is better acquainted than the experts he employs, and his careful consideration of the details of a plan before its installation is attempted may often obviate the necessity of changing methods once installed.

The first step toward the solution of any complex problem is a proper classification of all of the factors entering therein, and the most effective method to use in designing a plan to meet the needs of a complex industrial situation is to show clearly on paper the various elements and interrelationships involved, and then to follow a similar method in formulating and presenting plans to meet the conditions existing.. From the standpoint of the engineer engaged in the work of applying scientific management principles, and in the introduction of improved routine methods, such a method of procedure presents marked advantages. Not only does it aid in clarifying the problems of the engineer but it also provides for all effort expended being directed toward a clearly defined end and reduces the amount of supervision required. In the event of any change of organization it enables work to proceed without embarrassment.

In Figure 1 is reproduced a section of a drawing illustrating this idea of showing the operation of a plan in considerable detail and in diagram form.

REASONABLE REQUIREMENTS OF A COST SYSTEM

Though it is obviously somewhat difficult to submit any definite standards for cost accounting methods broadly, as these will depend greatly upon the character of the business and to some degree upon the ability of the organization and the extent to which it can make good use of the information which would be obtained, certain more or less general requirements can be stated.

As an illustration of the extended scope of a properly designed cost system, the following list is given of demands which should reasonably be made of such a system for a concern manufacturing a varied line of metal parts, some standard and some special, the manufacture of which involves the use of a considerable variety of machines.

1. ACCURATE COST OF SPECIFIC ARTICLES

The system should provide for the tabulation of cost data in such form that accurate and prompt information can be obtained as to costs by operations and in total of parts, part-assemblies and final assemblies. Not only should the system furnish information as to costs actually realized but, more important still, it should provide prompt and accurate data as to what costs should be under current conditions. In fact, in the business of today a cost system that does not provide for pre-determination of costs cannot be regarded as in any way meeting requirements. In many cases an article is placed on the market before it has been manufactured in sufficient quantities to render the data obtained a reliable guide as to what the cost should be in manufacturing on a commercial scale and, unless some reliable method of predetermining costs is followed, fixing the sales price of the article is largely a matter of an intelligent guess.

In concerns manufacturing a standard product, no matter how complicated, a system of cost accounting if properly designed should enable accurate information of the current costs of manufacture to be obtained very promptly. For instance, in a business such as the manufacture of agricultural implements, where many different kinds of machines are manufactured, it should be possible for the cost accountant to furnish an approximately accurate cost of any machine under current conditions in less than half an hour after the information is called for, and this should be so even if the machine in question comprises several hundred parts and necessitates the performance of five times as many operations.

2. MANUFACTURING EFFICIENCY DATA

Labor. The cost system should furnish the completest data relative to manufacturing efficiencies and in particular such information as the following:

The efficiency of the individual operator daily, weekly or at longer periods.
The efficiency of a class of workers.
The efficiency of a department.
The efficiency of a plant as a whole.

Furthermore, increases or decreases in cost should be analyzed into:

Those resulting from increases or decreases in the rate of wages paid.
Those resulting from increases or decreases in the time consumed in the performance of manufacturing operations.

Material. The system should provide for showing daily, weekly or monthly, as desired, increases or decreases in cost:

Resulting from variations in the purchase price of material.
Resulting from variations in the efficiency of the use of material, this being analyzed as to: individual operators, classes of operators, a department and a plant as a whole.

Manufacturing expenses. The increases or decreases in cost resulting from variations in expense should be shown in the completest form, and in particular the following information should be provided:

Handling and transporting expense. Increases or decreases in cost should be shown for the various main classes of material and for miscellaneous stores and supplies.

Power. Records should show increases or decreases in power cost analyzed as to:

Those resulting from variations in the cost of power.
Those resulting from variations in the efficiency of use of power.

In the former case cost fluctuations should be analyzed as to:

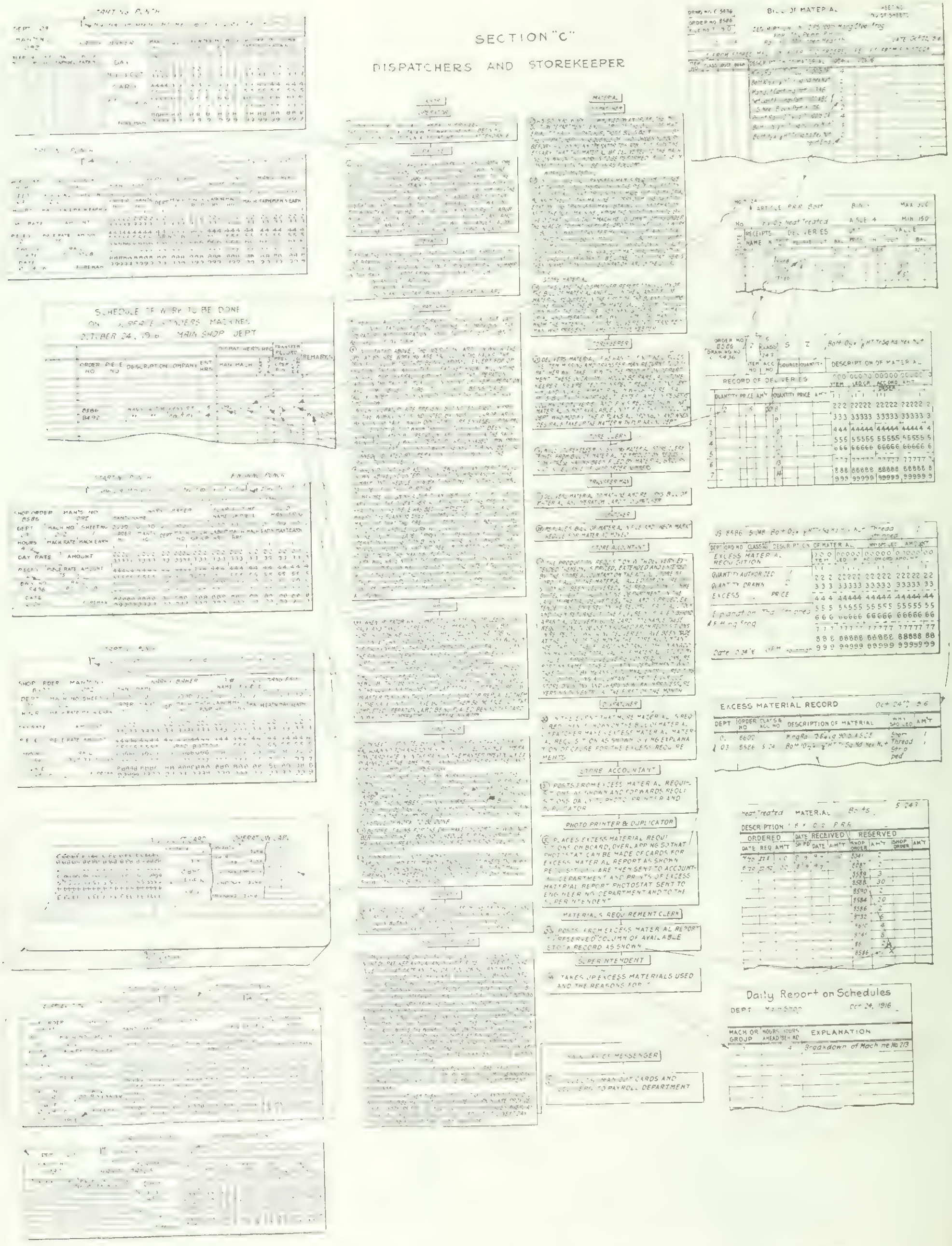

SECTION "C"
DISPATCHERS AND STOREKEEPER
SCHEDULE OF WORK TO BE DONE
BILL OF MATERIAL
RECORD OF DELIVERIES
EXCESS MATERIAL REQUISITION
EXCESS MATERIAL RECORD
STOREKEEPER
TRANSFER MAN
DISPATCHER
STORE ACCOUNTANT
PHOTO PRINTER & DUPLICATOR
MATERIALS REQUIREMENT CLERK
SUPERINTENDENT
Daily Report on Schedules

FIG. 1. DIAGRAM [illegible] OPERATION OF COMBINED COST AND PRODUCTION SYSTEM

Cost of coal, unloading and handling, power purchased, labor, repairs and supplies.

Miscellaneous stores and supplies. Increases or decreases in cost should be shown divided by departments, and, if desired, by individual operators. These increases or decreases should be analyzed as to:

Those resulting from variations in the purchase price of supplies.

Those resulting from variations in the efficiency of use of supplies.

Tool costs. Information should be provided showing the daily, weekly or monthly variations in the cost of tools divided as to:

Classes of machines, or individual machines when desired.
Departments.
A plant as a whole.

In addition, such variations should be analyzed to show increases or decreases resulting from:

Fluctuations in the purchase price of tools or in the cost of making them.
Variations in the efficiency of the use of tools.

Machine costs. Very complete information should be provided as to machine efficiencies, this showing increases or decreases in cost resulting from:

Variations in the number of hours a machine is operating.
Variations in the production efficiency of the machine when operating.
Variations in the cost of maintaining and operating the machine.

Spoilt work. Increases or decreases in cost resulting from fluctuations in the loss resulting from spoilt work should be shown daily, weekly or monthly divided as to: individual operators, classes of operators, classes of product, departments and a plant as a whole.

Miscellaneous works expense. Full information should be provided as to increases or decreases in costs resulting from variations in actual expense compared with standard, this data being arranged under the account classification most suitable for the business.

3. Promptness in Furnishing Information

The value of information relative to the cost of manufacturing operations is generally in direct ratio to the promptness with which such information is furnished. Though it is not usually feasible to provide complete statements covering all of the operations of the business at very short intervals, owing to the expense which would be involved, at the same time there are certain very necessary reports which should be furnished to the shop executive every day.

The following is indicative of the character of the information which should be provided daily:

Summarized manufacturing report showing:

Goods ordered, manufactured and shipped today and to date. divided as to classes and by any further sub-division desired.

Summarized payroll report showing by departments:

Number of employees on roll.
Number of employees absent or working short hours and total hours so lost.
Actual hours worked by operators.
Standard hours of work produced by operators.
Percentage of efficiency realized.
Payroll of operators.
Average rate per hour of operators.
Hours worked other than by operators.
Payroll of employees other than operators.
Average rate per hour of such employees.
Total hours worked by all employees.
Average rate per hour earned by all employees.

Summarized machine report showing for each machine and class of machine:

Standard hours.
Actual hours worked.
Employment efficiency.
Standard production.
Actual production.
Operating efficiency.
End efficiency.

In addition to providing for information being furnished daily to the shop executive in the form of summarized reports as described above, provision should be made in the design of the cost system for all data relative to costs and operations being so compiled as to render it possible at any time to obtain very promptly any arrangement of such data required.

4. Reports for the Manufacturing Executive

All of the information compiled by the cost department should be brought to a definite focus and presented to the manufacturing executive in a single monthly statement which should reflect in a few figures all of the salient features of the month's operations.

This statement should show comparisons of actual costs of operation for the month with standards, divided under such main captions as:

Material by classes, distinguishing between fluctuations in the purchase price of material, and in use efficiency.
Labor by departments, distinguishing between fluctuations in the rates of wages paid and in the efficiency of operating times.
Tools by departments, distinguishing between fluctuations in the cost of purchasing or making tools, and in the efficiency of use of tools.
Machines by departments, distinguishing between efficiency of employment, of use, and of operating and maintenance cost.
Spoilt work by departments.
Power cost.
Transporting and handling material.
Miscellaneous works expenses.

Supporting the summarized statement should be detailed statements providing the manufacturing executive with the fullest details as to the inefficiencies disclosed in total on the summarized statement. For instance, assuming that a high figure of increased tool cost on the summarized statement attracts the attention of the manufacturing executive, reference to the supporting tool efficiency statement should indicate exactly in which departments and machines such increased costs were incurred.

The system should of course show monthly the net profit realized from operations, gross profits being shown as to lines, specific articles or under such classification as is best suited to meet the needs of the particular business. Furthermore, the statements should clearly indicate the extent to which fluctuations in profits have resulted from variations in the prices realized for the product and from variations in the cost of manufacture.

5. Sales Statistics

The system should be designed to enable any reasonable refinement of selling efficiency data to be obtained. In particular, such information as the following should be provided:

Profits realized by salesmen.
Profits realized on different lines.
Profits realized in territories.
Profits realized by different classes of customers.

In addition, it should be possible to obtain expeditiously any combination of the above information, as for instance:

Profits realized by salesmen on each line.
Profits realized on different lines by territories, etc.

In addition to providing for very complete data relative to profits and losses realized from actual deliveries to customers, the system should render it possible to obtain at least approximately correct information relative to the profits which should be realized on orders accepted but not filled. The predetermination of profits is a corollary to the predetermination of costs and though figures as to the former will be accepted by the wise executive with due reservation, properly used they should prove of the greatest assistance in his direction of the policies of the business. Furthermore, with a properly designed system the executive is furnished each month with full information as to where the actual results have varied from the estimates, and as to the causes for such variations, so that he is enabled to adjust his plans to conform to fluctuating conditions. Whereas in the past executives were satisfied with receiving annual statements of profit and loss, and in the present are in many cases content to obtain monthly information as to profits actually realized, in the near future they will demand the predetermination in large measure of costs and profits. In place of working to a more or less nebulous end, each member of the organization will have definite standards to strive for, the extent to which such standards have been realized being reflected in the cost accounts and in the reports to the executive.

Business men are gradually emerging from the retrospective to the prospective attitude and in the writer's opinion, the accountant of the future will spend more time in making intelligent forecasts for immediate utilization than in recording past events: mere history.

6. Cost of Operating the System

The cost system should be economical as regards:

Executives, whose time in many organizations is wasted to an appalling degree in the endeavor to extract vital information from the mass of undigested information presented to them.

Clerks.

Shop employees, in particular, as regards time spent in making out detailed time distributions, weighing material, etc.

To this end the system should be coördinated with the work of the production and allied departments so that duplication of work and overlapping of authority with their consequent confusion can be avoided.

7. Standard Practice Instructions Re System

The plan of the system and the details of its operation should be clearly laid down in diagram form so that employees can easily understand the routine involved and the relation of their work to the general scheme. There should be no possibility of things being done wrong owing to the absence of the clearest possible instructions as to the right way in which to do them. Under this head will come the provision for a complete descriptive card of accounts that will leave nothing to the imagination, for this, though a faculty of great value in certain conditions, is distinctly out of place in account distribution.

Typical Plan in Relation to Above Requirements

In considering the more usual cost accounting methods in relation to the above requirements, it is necessary for the sake of clearness to take some specific case as a means of illustration and therefore in Figure 2 is shown the underlying principles of a cost system employed by a concern manufacturing a varied line of standard machinery, many of the parts of which are common to several machines and where accordingly parts are manufactured for stock and issued on assembly requisitions, this being a condition common to manufacturers of standardized machinery. It may be mentioned that the plan illustrated is still somewhat generally regarded as an efficient method of cost accounting. In considering this plan no attention is given to questions of burden distribution, etc., but merely to the basic method used in the determination of costs.

Considered from the standpoint of the first of the requirements enumerated above, namely, the obtaining of information relative to the cost of specific articles, it will be seen that under the plan illustrated a detailed account is maintained for the cost of each batch of parts manufactured. To the cost of these parts is charged the actual labor cost of the work performed thereon and the cost of the material used. Burden is distributed monthly to the cost of parts, part-assemblies and final assemblies. Parts used in assemblies are charged to the assembly cost card on the basis of the average cost of such parts as shown by the parts' cost card. The cost of the assemblies includes also the cost of assembling material used and assembling labor and burden. The final assembly includes the average cost of part assemblies as shown by the assembly cost cards, thus summing up and assembling labor, material and burden.

Former Idea of Costs Retrospective

Until recent years the purpose of practically all cost accounting systems was confined in the main to the ascertainment of information relative to costs actually realized, of which idea the system now being considered represents a typical example. This being the primary purpose of this system, data obtained therefrom as to operating efficiencies being merely incidental, as explained later, the question naturally arises as to what is the value and what are the limitations of cost records compiled after the event.

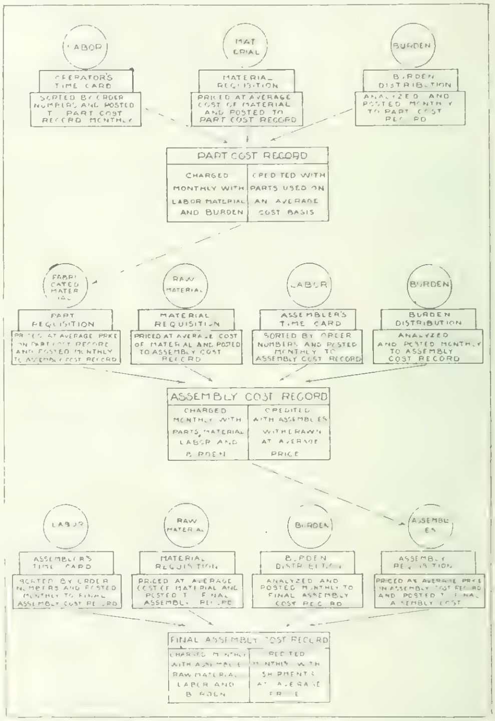

LABOR
MATERIAL
BURDEN
OPERATOR'S TIME CARD
SORTED BY ORDER NUMBERS AND POSTED TO PART COST RECORD MONTHLY
MATERIAL REQUISITION
PRICED AT AVERAGE COST OF MATERIAL AND POSTED TO PART COST RECORD
BURDEN DISTRIBUTION
ANALYZED AND POSTED MONTHLY TO PART COST RECORD
PART COST RECORD
CHARGED MONTHLY WITH LABOR MATERIAL AND BURDEN
CREDITED WITH PARTS USED ON AN AVERAGE COST BASIS
FABRICATED MATERIAL
RAW MATERIAL
LABOR
BURDEN
PART REQUISITION
PRICED AT AVERAGE PRICE ON PART COST RECORD AND POSTED MONTHLY TO ASSEMBLY COST RECORD
MATERIAL REQUISITION
PRICED AT AVERAGE COST OF MATERIAL AND POSTED TO ASSEMBLY COST RECORD
ASSEMBLER'S TIME CARD
SORTED BY ORDER NUMBERS AND POSTED MONTHLY TO ASSEMBLY COST RECORD
BURDEN DISTRIBUTION
ANALYZED AND POSTED MONTHLY TO ASSEMBLY COST RECORD
ASSEMBLY COST RECORD
CHARGED MONTHLY WITH PARTS, MATERIAL LABOR AND BURDEN
CREDITED WITH ASSEMBLIES WITHDRAWN AT AVERAGE PRICE
LABOR
RAW MATERIAL
BURDEN
ASSEMBLIES
ASSEMBLER'S TIME CARD
SORTED BY ORDER NUMBERS AND POSTED MONTHLY TO FINAL ASSEMBLY COST RECORD
MATERIAL REQUISITION
PRICED AT AVERAGE COST OF MATERIAL AND POSTED TO FINAL ASSEMBLY RECORD
BURDEN DISTRIBUTION
ANALYZED AND POSTED MONTHLY TO FINAL ASSEMBLY COST RECORD
ASSEMBLY REQUISITION
PRICED AT AVERAGE PRICE IN ASSEMBLY COST RECORD AND POSTED TO FINAL ASSEMBLY COST
FINAL ASSEMBLY COST RECORD
CHARGED MONTHLY WITH ASSEMBLIES RAW MATERIAL LABOR AND BURDEN
CREDITED MONTHLY WITH SHIPMENTS AT AVERAGE PRICE

FIG. 2. DIAGRAM SHOWING ESSENTIAL FEATURES OF TYPICAL COST SYSTEM FOR STANDARD LINE OF MACHINERY

In a business such as that for which the system being described was designed, it is contended that information relative to past costs is of very limited value. The manufacture of parts being for stock, these parts being withdrawn as required for assembling, it will be understood that it is not only possible but highly probable that the parts included in any machine represent the result of manufacturing operations extending over a considerable period of time, so that the final cost of a machine will represent a conglomeration of data involving material, labor and burden figured at the various prices extending over the period covered by the operations involved in the manufacture of the machine. Such a cost will in itself afford very limited information relative to the current cost of building a machine and with fluctuating material prices and labor and burden rates a manufacturer would certainly not feel justified in accepting a cost so compiled as the basis for making a selling price. Even if all of the parts required are actually on hand it would seem that the correct basis on which to figure selling prices would be that of replacement cost, not actual cost, for in the event of a falling market purchasers would expect to be given the benefit of the reduced material prices and correspondingly the manufacturer should be entitled to realize the profit resulting from purchasing material before the rise in price.

The whole conception of a cost system which concentrates solely on the obtaining of data relative to past results is unsound, belonging to the days when the manufacturer was satisfied if some time after the end of the year his accountant presented him with a statement showing the annual net profits realized. To be able to operate a business with the maximum degree of safety and profit, before any work is undertaken there should be an intelligent estimate of what its cost will be, this estimate providing a standard of attainment and a definite incentive to economical manufacture.

Under the plan described, in order to obtain reliable information as to current costs it is necessary to refigure the costs already compiled, on the basis of current conditions—a makeshift method for which the system is not adapted and one involving a great expenditure of time and considerable delay.

Difficulty of Shifting Costs of Labor and Material

A system such as is being discussed may give fairly useful information as to costs during periods of a more or less constant condition of the material and labor markets, but in times of flux, as at present, such a system is liable to prove a danger in giving misleading information, which if accepted as correct may result in serious loss.

Generally speaking, it would appear that this system gives little available cost data except for the purpose of valuing inventories and, even here, it may be questioned whether the costs so obtained should invariably be used for inventory purposes. Public accountants have adopted the principle of valuing raw material in inventories at current market price or actual cost, whichever is the lower, but it will be readily seen how difficult it would be under the plan described to refigure the material included in work-in-progress and finished machines on a market basis, so that in the majority of cases the auditor while adjusting the raw material inventory to take care of a fall in the price of raw material will be inclined to accept the work-in-progress and finished work at their cost as shown on the records, owing to the difficulty of ascertaining the difference between the actual cost of the material included therein and the market value thereof.

Considered from the standpoint of the second reasonable requirement of a cost system, namely, the furnishing of complete data relative to manufacturing efficiencies, it must be admitted that the plan described fails totally to meet the demands. Hardly any other result could be expected when it is considered that the plan concentrates almost exclusively on obtaining "costs" and ignores the equally if not more important question of "causes."

Effort to Trace Causes of Cost Increases

In a business such as has been described, a certain machine or batch of machines completed this month may show an increase in cost as compared with a previous batch, and the manufacturing executive will call for information as to the cause underlying this increase. This will result in an interminable and unsatisfactory investigation—comparisons of the costs of the individual parts will be made—this part is charged to this machine at five cents more than the previous charge. Why? In any one part increases or decreases may be due to the combination of a number of causes. For instance:

> In the month when this part was made the forge shop was not very busy so the burden rate of that department was increased.
>
> This work was done on a machine not suited to it, owing to the regular machine not being available. The machine used was more expensive to operate than the regular machine.
>
> There was a heavy spoilage on that batch of parts owing to an incompetent operator or due to a defect in the material.

The investigation of the increased cost of the machine being considered will call for a complete analysis of the costs of all parts showing increases and it may be readily imagined how impossible it would be to bring to a focus information so obtained as to increases in the cost of several hundred parts and probably five times as many operations. Furthermore, under this plan of only considering increases in costs, serious inefficiencies may be overlooked owing to these being offset by the elimination of previous inefficiencies and consequently the total cost of a part remains approximately the same as before. In addition, it may be urged that comparisons with past costs though having their place and being of value when nothing better is obtainable are of minor importance contrasted with comparisons with standards based upon what the cost should be rather than what it was.

After a few unsatisfactory investigations of this kind an executive will soon lose interest in obtaining efficiency data from an analysis of detailed costs, and the work of the cost department will become more or less perfunctory and resolve itself into the somewhat usual state of affairs where a mass of information is compiled of which little use is made.

It seems strange that this method of comparison should be regarded as being at all adequate to meet modern requirements, but in a recent book by a well regarded writer on cost accounting, discussing the value of a detailed system of cost accounting to show the reason for not making a profit on an order for a machine, we find the following:

> But supposing that after all, it was found that we had not made a profit, but a loss instead. What should be done to discover the reason for this loss?
>
> The need for a comprehensive and detailed system of production orders, enabling us to ascertain the cost of each part or component of the machine would be forced upon us. And probably we should not be satisfied even with this. We should also require to know the separate cost of each process or operation on each dissimilar piece. Thus, if the baseplate were in question we should want to know the cost of the metal contained in it, the cost of molding, the total foundry cost: the cost of planing, drilling and hole slotting and scraping the sides, and whatever other operations were performed on the baseplate separately. *Only by doing so, and by being in a position to contrast such detail costs with the costs of similar pieces done on a previous occasion could we conduct our business intelligently and safely.*

The italics above are those of the writer of this article. It should be noted that the author quoted assumes that the above investigation and cost comparison will be undertaken after it is discovered that a machine has been sold at a loss when it should have realized a profit. There are those who may question the value of such post mortems, especially when it is remembered that in many factories hundreds of different parts, involving thousands of separate operations, may be worked on in a month.

Some information as to efficiencies is demanded by every progressive works manager, so the method of obtaining efficiency data by analyzing detailed costs proving ineffective, there soon develops a subsidiary system from which statements are prepared comparing the results obtained with more or less arbitrary standards. Among these we may mention our old friend the ratio of so-called non-productive labor to productive labor, under which every shop man schemes to include all possible labor expense under the latter head without reference to whether it belongs there or not. This must be carefully avoided.

Fallacy of Low Non-Productive Labor Percentage

This brings to mind a case which came to the attention of the writer where one factory, in a concern operating several, was for years held up as an example to the rest of the factories because of its low percentage of non-productive labor. An investigation, however, disclosed the fact that in this particular factory all employees working in the shop, including the foremen, were reported as productive labor, whereas in the other factories foremen were reported as non-productive labor. A curious feature of such a method of comparison is that it entirely ignores the actual efficiency of operators so that all that is required to enable a foreman to make a most excellent showing, according to this standard, is to increase the productive payroll without increasing the production. In an actual case a foreman introduced an improvement in a machine which resulted in one man being able to do the work which formerly required two. The natural result in the month when this improvement went into effect was an increased ratio of non-productive labor, for this payroll remained constant whereas the productive labor was reduced and as a consequence the foreman in question was sent for and solemnly reprimanded for his poor showing!

Another favorite fetish of works managers is the ratio of piece work to day work. Where this false ideal is most consistently regarded it will be found that practically all jobs are piece work, and many cases have come to the attention of the writer where the foreman did not have the remotest idea of the time a job should take and issued it to a workman on an hourly rate basis. After the completion of the work he would divide the man's earnings by the production, reporting the result as the piece-work rate and the man's earnings as piece work instead of day work; a fallacy!

Injustice of Per Pound or Per Piece Factors

A very usual form of presenting efficiency data is to show the departmental cost per pound or per piece of the product manufactured, whereas in many cases the variations in size and complexity of work cause legitimate fluctuations in cost amounting to five times as much as any possible variation in efficiency. Statements prepared on this basis are more often a source of irritation than a spur to efficiency. A foreman is sent for around about the end of the month and told that in the previous month his labor or tool expense per pound or per piece was so many per cent. over the month previous. He immediately begins to rack his brain for some reason why this condition arose and probably remembers some particular order which gave him trouble and hopefully advances this as a reason for the poor showing. Of course, the cost system does not provide any specific information as to the causes underlying variations in costs so that the argument is more or less ineffective and the foreman leaves the cost department with a poor opinion of the cost system and with little faith in any information emanating therefrom.

The writer was partly responsible many years ago for the introduction of a system under which foremen were paid a bonus based upon the decreases in costs per pound or per piece in their departments. Undoubtedly, this plan had a good moral effect but the writer blushes to think how the system must often have rewarded the inefficient and penalized the competent. Primarily it was wrong, for it based its rewards on comparisons with results previously attained so that the worst organized department where savings could most easily be effected was the one where the greatest rewards were possible and, in fact, given a department 100 per cent. efficient at the start it would be theoretically impossible under this plan for any bonus to be earned at all. Again, any change in the character of work done in the department might quite easily result in legitimate cost variations per pound or per piece many times offsetting any possible variations resulting from fluctuations in efficiency. Furthermore, no distinction was made in the case of such items as stores or tools between increases and decreases in cost resulting from variations in the price paid for stores and tools and those which were due to fluctuations in the efficiency of their use. Under this plan it would have been perfectly possible for a foreman to have earned a bonus because of a tool saving in his department, whereas more than the total of such saving might have represented a decreased cost resulting from a reduction in the price of tool steel, the actual consumption of tools per unit of product having increased.

The method described of showing information as to the cost of operating the departments of a factory in relation to standards is, of course, based on a perfectly correct idea, and the absurdities referred to were only due to the absence of proper standards and of an adequate accounting mechanism for providing comparisons of actual costs therewith. The almost universal attempts which are made to supplement the information produced by the detailed cost accounting methods are, in fact, excellent proof that the average works manager realizes the shortcomings of the detailed cost system in force and appreciates the fact that unless costs are shown in relation to some standard they are of little value as a means of increasing the efficiency of a factory.

A criticism which is commonly made of the average cost system is the delay which is experienced in furnishing information to those for whose benefit it is compiled. Promptness in furnishing information is the third of the reasonable requirements of a cost system, and in the system which is being criticized it would be difficult to provide data as to costs until some time after the close of the month, as it is inevitable under the plan employed for the bulk of the cost accounting work to be concentrated in the period immediately following the end of the month. The more promptly a system discloses inefficiencies the more quickly can the unfavorable conditions be corrected and unless a system provides for daily reports covering the more important phases of the manufacturing operations it can hardly be considered suitable to meet modern, comprehensive requirements.

INELASTIC METHODS OF COMPILING INFORMATION

A fundamental defect of most cost accounting systems is the inelastic method employed in compiling information. Original data are tabulated in such a manner that any rearrangement to meet any other need than the specific one for which the tabulation was made necessitates a complete, laborious retabulation by hand of the original data. By the employment of modern accounting machinery in conjunction with a plan scientifically drawn up to take advantage of the opportunities afforded thereby it is possible to arrange for any combination of original data to be obtained promptly, accurately, at little expense and more reliable than older systems can give.

DEFECT OF LACK OF FOCUS

An outstanding defect of the system being discussed and in fact of practically all detailed cost systems is in relation to the fourth requirement enumerated, namely, the necessity of a system of cost accounting being so designed as to render it possible to bring cost information to a focus for the benefit of the manufacturing executive. From the comments already made on the particular plan described it will be evident that under such a method it would not be possible to compile a comprehensive statement which in a few figures would provide the executive with a bird's eye view of the salient features of the month's manufacturing operations. Executives who endeavor to make use of the information prepared for them by their cost department are engaged in a constant struggle to extract the essential facts necessary for their guidance in the operation of the business from the mass of detailed data presented to them, and it is hardly strange that they sometimes wonder whether the time and money expended in maintaining a cost department is really worth while.

Reports to executives should be based on the principle of exceptions and in place of providing a mass of detailed and undigested information should be drawn up to indicate clearly and unmistakably where exceptional or abnormal conditions exist. The manufacturing executive should primarily be interested in information showing the trend of efficiencies and the reasons underlying fluctuations therein. Under the detailed cost system the ideal aimed at is entirely the opposite for the basic purpose underlying this plan is to merge all expenses so far as possible into the detailed costs, so that the more nearly such a plan reaches its logical conclusion and the more complete and elaborate the methods of distribution the more inextricably are inefficiencies buried in the detailed costs. In many manufacturing concerns a serious cause of loss is due to spoilt work and the total loss from this cause is certainly information required by the manufacturing executive, but the writer has examined numerous detailed cost systems where such losses only showed on the cost records as affecting the cost per piece of the parts spoiled.

IMPORTANCE OF SALES STATISTICS

When its importance is considered, it is a matter of surprise that so little attention relatively has been given to the question of sales statistics, the fifth caption in the list of requirements of a cost system. It is true that a great deal of data is compiled in many institutions covering some phases of the activities of the selling organization and there are in fact few concerns of any size that do not possess records showing the gross sales made by each salesman and in each territory. It is rarely, however, that reliable information is obtained as to the actual net profits earned by a salesman except in those cases where the product is a simple one and the figuring of the profits correspondingly easy. The direct result of this lack of information is that even salesmen who are not paid on commission strive more toward obtaining a large volume of sales than the realization of net profits.

In a business handling a varied and complex product it is not feasible, of course, to obtain the somewhat extensive line of information specified in the list of requirements unless the system of cost accounting has been skillfully designed with this object in mind, and original data is compiled in such form as to render it possible by the use of accounting machinery to obtain expeditiously and inexpensively any combination of information required.

The expense of operating a cost system should be considered more as regards the relation of the cost to the results obtained than solely as to the actual money expended in maintaining the system. When both factors of actual outlay and benefits received are taken into account it will be found that the average cost system is unduly expensive. Not only is the actual cost considerable but the results obtained are of limited value. A detailed system of cost accounting such as has been described involves a great amount of clerical work not only in the cost department but on the part of the workmen making out detailed time reports. In connection with the latter, as will be explained later, it is often possible to eliminate a great proportion of the clerical work performed in the shops and at the same time very much increase the utility of the information obtained.

The relatively high cost of the average detailed cost system is largely due to the immense volume of comparatively useless information which is compiled and also to defects in the design of the system, for as previously stated a common fault of many cost systems is that basic information is tabulated in such a manner as to render it necessary to retabulate this by hand before any rearrangement of this data can be obtained; double work and double expense.

LACK OF COÖRDINATION

Another cause of unnecessary expense in the operation of a system of cost accounting is the lack of coordination between departments closely allied. This applies particularly to the relations between the cost and production departments which operate independently in the use of mainly identical information and where there is often found to be considerable duplication of effort. As will be demonstrated later on in these articles, the work of these two departments is so closely related that it should be considered as a single proposition and the two departments combined. There are few organizations where some loss is not experienced as a result of a lack of proper coördination between departments which should logically be intimately connected, an extreme instance of which was a case which came to the attention of the writer where the general accounting and cost accounting departments of a large business were so far divorced from one another that each of these departments issued entirely distinct cards of account, this necessitating the analyzing of all shop expenses twice, once for the general books and once for the cost records.

As regards the cost of obtaining the very complete line of information detailed in the list of reasonable requirements of a cost system, previously given, it may be stated that in the majority of cases it is perfectly possible to operate a system under which these results can be obtained at an expense no greater, and probably less than, that required to maintain the recognized detailed cost systems. In some cases the writer has been enabled to obtain the results desired at a very great saving over the methods previously employed, but in any event it may be stated that the expense involved in operating an accounting plan properly designed to apply the principles of scientific management is comparatively small considered in relation to the scope and value of the information obtained.

Dealing with the last of the requirements enumerated, namely, the importance of complete standard practice instructions covering the operation of a system of cost accounting, it has been found by the writer that even in large undertakings there is a lamentable lack of such instructions. In fact, it is only occasionally that a case is found where the methods employed have been seriously and systematically analyzed and studied with a view to eliminating duplication of work and improving the methods generally.

The lack of comprehensive instructions and detailed plans covering the operation of a system in its entirety, is a source of considerable weakness to the average organization. This condition renders a business entirely too dependent upon the specialized knowledge of individuals and further holds back the development of the junior members of the organization by limiting their horizon to the performance of their specific duties. With complete standard practice instructions, however, not only is the danger of having work done incorrectly owing to the absence of definite written instructions eliminated, but furthermore, when the plan of a system in its entirety is properly presented for the guidance of the organization as a whole, each member can learn exactly the place which his work fills in the general scheme of things and prepare himself for the day when his sphere of effort will be enlarged by his promotion to a better position.

The importance of standard practice instructions is being increasingly recognized in the field of shop practice, but in the sphere of cost accounting this and other principles of scientific management have been in a large measure neglected. In the writer's opinion, however, the day is fast approaching when as much attention will be given to the application of these principles in the office as in the shop, and the series of articles of which this is the first has been written for the purpose of demonstrating that in the field of accounting at least, great benefits can be derived from the use of these principles, and with the hope that increased attention will be given to this phase of the subject.

(To be continued)

Planning a Housing Development for an Industrial Plant

By Benjamin Wilk

THOUGH the housing of employees has been an important factor ever since the beginnings of factory production, it has not been given due recognition until the present time. With existing unusual conditions in the industrial field, with labor receiving unprecedented wages causing much unrest and therefore "turnover," the importance of the whole problem has assumed new proportions.

Several large companies have already started housing developments, and more are becoming interested since bills appropriating millions of dollars for loans for housing construction, both at shipyards and industrial plants, have been passed by Congress.

Analysis of Individual Problem

To determine how many houses should be built and what they should cost is frequently a baffling problem. By attacking it methodically, as was done by a large company in Pennsylvania, the solution is comparatively simple.

An analysis of each man was made to determine whether he would be interested in securing a house, how large a house he would need, and how much he could afford to pay.

Housing and transportation facilities at the mill are such that some of the employees live in the village near the plant, while others have sought and found better accommodations at more distant points, coming to work either on a work train or by a combination of street car and work train.

To simplify the study of the problem, a general social survey quickly pointed out that it was necessary to classify the men into three logical divisions:

1, office men and foremen; 2, plant laborers; 3, negroes.

These groups were further classified into three divisions, depending on salaries and wages.

For the office men and foremen on a basis of monthly earnings: 1, $80 to $100; 2, $101 to $140; 3, $140 and up.

For the second and third classes on a basis of daily wages: 1, $3.30 to $3.75; 8, $3.85 to $4.20; 3, $4.25 and up.

For the classification as to methods of reaching the plant, three groupings suggested themselves:

1, walking to plant; 2, riding work train; 3, using street car before riding work train.

From employment cards it was possible to determine if the men were married or single, how long they had been employed by the company, and if married, the number of children.

From these cards the tabulation of Figure 1 was filled out.

The first step was then to determine what monthly rents or payments could be expected from the men on the basis of 20 per cent. of the monthly salary or wage. Results were as follows:

Percentage	Maximum Monthly Rental
Better Class Houses	
15	$17
55	24
30	30
Second Class Houses	
40	17
40	20
20	24

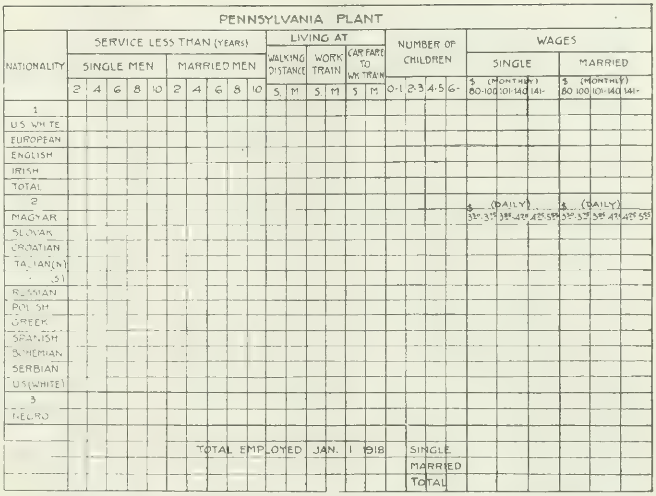
To determine what the houses would cost, and give a four per cent. net return, amortization tables and methods of financing were studied. Annuity payment, making the whole development free of encumbrance in 30 years, seemed most feasible.

On this basis an 8.7 per cent. gross return per year is necessary.

Annuity (including depreciation) on 30-year basis, with interest at 4 per cent., equals	5.7 per cent.
Maintenance equals	1.0
Taxes, water rents, incidentals equals.	2.0
Total	8.7

With the monthly rents or payments as previously mentioned, the cost of the houses complete with improvements should range from $2,500 to $4,320. Discounting the fact that the entire development on this basis will be free of encumbrance in 30 years, it will be seen that the houses will bring in a larger net return than four per cent.

In addition to the tabulation made from the employment cards the following questionnaire given below was sent out to all the employees and a tabulation made of the replies. See also Figure 2.



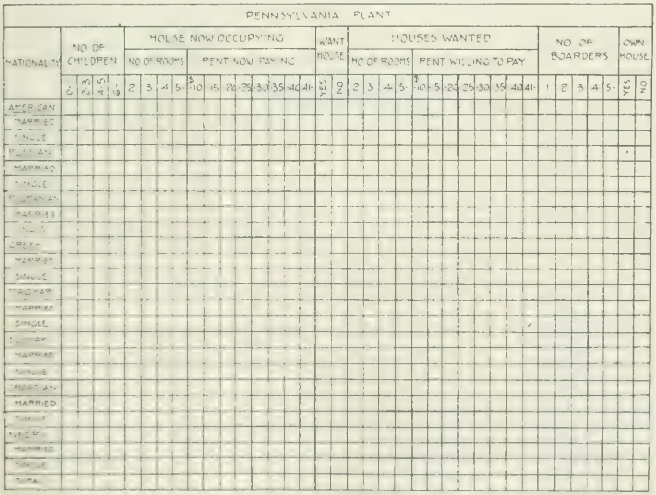
NATIONALITY	SERVICE LESS THAN (YEARS)										LIVING AT						NUMBER OF CHILDREN				WAGES					
	SINGLE MEN					MARRIED MEN					WALKING DISTANCE		WORK TRAIN		CAR FARE TO WK TRAIN						SINGLE			MARRIED		
	2	4	6	8	10	2	4	6	8	10	S.	M	S.	M	S	M	0-1	2-3	4-5	6-	$ (MONTHLY) 80-100	101-140	141-	$ (MONTHLY) 80 100	101-140	141-
1																										
U.S. WHITE																										
EUROPEAN																										
ENGLISH																										
IRISH																										
TOTAL																										
2																					$ (DAILY) 3.20-3.75	3.85-4.20	4.25-5.55	$ (DAILY) 3.20-3.75	3.85-4.20	4.25-5.55
MAGYAR																										
SLOVAK																										
CROATIAN																										
ITALIAN (N)																										
(S)																										
RUSSIAN																										
POLISH																										
GREEK																										
SPANISH																										
BOHEMIAN																										
SERBIAN																										
U.S. (WHITE)																										
3																										
NEGRO																										
								TOTAL EMPLOYED JAN. 1 1918									SINGLE									
																	MARRIED									
																	TOTAL									

FIG. I. TABULATION OF RESULTS OBTAINED FROM EMPLOYMENT CARDS

Housing Data as of January 1, 1918.

THE QUESTIONNAIRE

Name
Address
Check No.
Occupation
Age
Married or single
Wife resides at
Children living at home
Nationality
Naturalized
English speaking
Number of rooms in house you now occupy
Rent per month
Do you want house in desirable location near plant
If so, how many rooms
Rent per month
Do you keep boarders
If so, how many



NATIONALITY	NO. OF CHILDREN				HOUSE NOW OCCUPYING												WANT HOUSE		HOUSES WANTED												NO. OF BOARDERS					OWN HOUSE	
					NO. OF ROOMS				RENT NOW PAYING										NO. OF ROOMS				RENT WILLING TO PAY														
	0-1	2-3	4-5	6-	2	3	4	5-	$ -10	15	20	-25	-30	-35	-40	41-	YES	NO	2	3	4	5-	$ -10	-15	-20	25	-30	35	40	41-	1	2	3	4	5-	YES	NO
AMERICAN																																					
MARRIED																																					
SINGLE																																					
RUSSIAN																																					
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NEGRO																																					
MARRIED																																					
SINGLE																																					
TOTAL																																					

FIG. 2. CHART OF RESULTS BY TABULATION OF REPLIES TO QUESTIONNAIRE

Remarks

A few changes in the original estimates were made in accordance with the data obtained and the following suggestions made as to number of houses to be built:

Better Class Houses. 12—4 rooms at $17 per month (if necessary build double houses). 18—5 rooms at $22 per month. 10—6 rooms at $27 per month.

Second Class Houses. 3—4 apartment (3 rooms, terrace) at $14 per month. 40—4 rooms at $17 per month (if necessary build double houses). 5—5 rooms at $20 per month (if necessary build double houses).

For the third class it was suggested that 25 single houses and three boarding houses to accommodate 40 single men each should be built as the supply of labor could be partially controlled by the mill officials.

In addition to the single houses for the first two classes, it was suggested that one boarding house be built for 25 men and two boarding houses for the second class, to hold 30 to 40 men each. These boarding houses can be built at a cost of approximately $400 per man.

In determining where the houses should be built, a general survey of the land must be made and the streets and lots laid out by an experienced town planner. Knowing the number of houses and the cost, it is easy to lay out an attractive housing development which will mean that the workmen will have comfortable homes, that a better class of workmen will be attracted, that a stable supply of contented workmen will be constantly on hand, labor "turnover" will be decreased, and the efficiency of the plant increased.

A study and investigation of this kind will go far toward overcoming the unsatisfactory conditions outlined at the beginning of this article. The scheme must be carefully and comprehensively worked out, however, in order to provide sufficient housing facilities in a reasonable time, yet be insured against future lowering of demand under less favorable industrial conditions for houses and rooms involving a large initial outlay.

Graphic Production Control--II

The Fifteen Laws of Control

By C. E. Knoeppel

To control production its laws must be known and heeded. So before showing how to use graphics in control Mr. Knoeppel *devotes one entire paper in his series to declaring, amplifying and explaining the fundamental laws. Every industrial executive might well learn them by heart.*

Mr. C. E. Knoeppel, *founder and president of the firm of C. E. Knoeppel & Co., Inc., consulting engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three firms of industrial engineers. This experience ultimately led to the founding of the organization of well qualified consulting and management engineers and experts of which he is now head and director.*

THE Bible should have contained this commandment, "Put not thy faith in devices, forms and systems, but be ye chiefly concerned regarding principles and laws, for in their acceptance there is much reward."

The September installment of this series considered the underlying factors of "graphic production control," and before proceeding to the matter of the application of graphic methods, it is important to devote a single paper to a treatment of the laws of graphic control.

In the first place what are we going to try and accomplish through the use of graphic control? Let us put it in the form of an ideal or standard:

The time to consider the matter of manufacturing a definite number of units of production, in a definite time, within a definite cost limit, at a definite efficiency, is BEFORE the work is started in the shops, and not after.

How will we convert this ideal into a practical reality? We can answer this by defining "graphic production control," as

That mechanism which provides a means whereby, through visualization or graphical presentation, all details in connection with production can be intelligently planned in advance, and efficiently dispatched; whereby each machine, man or gang can work with reference to all the other machines, men or gangs; whereby the shop management can, through advance knowledge, provide the necessary elements in the way of materials, machines, tools, drawings and labor.

Laws are rules that have no exceptions. Violation of them brings disaster. Success comes only by following them faithfully to the end. The laws of production are as fundamental and regulative as any others, although they may not be as readily seen and as easily followed as so-called natural laws. But every violation is followed by punishment and failure; keeping them brings output — the great result of proper productive effort.

The above is virtually the definition of a principle, as "control" is the third principle of the author's now generally accepted six principles of industrial engineering: Investigation, coördination, control, records, standardization and incentives.

Now the point is—after providing a practical ideal and defining the principle of control—what are the laws through which we can secure the results outlined? They are several in number as follows:

1. *Centralization.* Given a plant and equipment, with an organization to handle the work, the manufacturing of all that is designed by the engineering department and sold by the sales department, can be handled to best advantage only when the details, instead of being considered independently by each department, *are controlled by one function.*

2. *Scope of control.* Control should be as much concerned with engineering, purchasing, tool and jig work, as with foundry, machine shop and assembly methods and operations.

3. *Draw versus push.* Work should be *drawn* through a shop from the erection end, and not *pushed* through the engineering, purchasing, foundry and machines to sub-assembly, assembly and erection.

4. *Requirements.* Requirements in the way of units to manufacture must be known in advance, so as to allow time to arrange for proper control.

5. *Assignment of work.* Assignment of sufficient work must be made in advance, to keep equipment and men operating at maximum capacity, without injury to condition of equipment or health of men.

6. *Importance and availability.* Relative importance and availability of all work must be known and considered in controlling production.

7. *Operations.* Operations must be standardized as to sequence and manner of working, and estimated or standard times established, for all work which is to be graphically controlled.

8. *Labor.* No man should do any work that can be performed as well by another, with less skill and at less expense, or with greater skill or more expert attention.

9. *Equipment.* Equipment should be standardized, kept properly repaired and the proper balance maintained for efficient production between types and sizes.

10. *Materials.* Material should be under positive control at all times, to insure adequate quantity, proper quality and efficient movement.

11. *Starting operations.* The selection of a starting operation, whether making a jig, buying material or starting a machining operation, is governed by that element, the starting point of which *is furthest from the finishing point.*

12. *Succeeding operations.* No succeeding operation should be started in a plant, when its ratio to the preceding operation *is less than one to one.*

13. *Lots.* Lots should be directly proportional to the ratio of handling time (set-up time) to the operation time, and inversely proportional to the size or weight or the value of the material.

14. *Costs.* The same mechanism that is used in

graphically controlling production, should also furnish costs of production as a by-product.

15. *Organization.* The functions of control should be properly determined and authority, duties and responsibilities worked out and followed.

Laws of Control Are Fundamental

The laws of control are much more fundamental and important than a casual reading indicates. Unless they are accepted and obeyed, no real production control is at all possible and the reason why so many concerns secure only ordinary results from their control methods, is because there is a violation of one or more of the laws.

In one case a survey resulted in the following report, which is self-explanatory and shows conclusively that many of the principles were not considered:

> After our preliminary study of your operations, we tried to match betterments against your requirements as a test, but found we could do little for the following reasons:
>
> 1. We did not find an analysis of parts from the standpoint of importance to sub-assembly and final erection. Lacking this it is impossible to work up sequence and flow of parts and sub-assemblies.
> 2. Little has been done in the matter of standardizing operations or supplying records with sequence of operations on parts. Without this knowledge it is impossible to route parts through the shops.
> 3. There are no estimated times for operations on file. This is necessary in planning, in order to estimate the length of time to allow for work at the different points of travel.
> 4. While you have part orders, there are no regular manufacturing orders for building a definite number of certain models, making it a difficult matter to know what to control.
> 5. You have orders in the plant for too long a time. This not only holds up your records but increases the chance of errors creeping in, or having the orders lost or sidetracked.
> 6. You do not have your stock situation under the kind of control that would enable the planning department to depend upon these records, which would mean constant changes and corrections in schedules.
> 7. Your time reports are loose and unreliable, as the men keep their own time or your clerks enter what the men tell them. Correct times and correct counts are essential in watching and controlling progress, from day to day, of work which has been planned.
> 8. You have too many changes and errors during process of manufacturing, to schedule intelligently the work of assembly and testing. These departments, not knowing what is coming to them from serving departments, cannot get things in readiness in advance. Very often they have to do extra work because of a failure to complete work on a preceding operation.
> 9. Due to the present congestion in .the shops it would be exceedingly difficult to control production efficiency without a full knowledge of what is in shop and the conditions with reference to completion.
> 10. Because of the lack of advance information, departments do not know in all cases what is coming to them, until material arrives on the floors. Under these conditions no scheduling is at all possible
> 11. Weaknesses in both tool room and inspection departments would interfere at present with attempts to schedule work properly through the plant.
> 12. As was repeatedly pointed out, there is an almost entire absence of systematic shop procedure, the unforeseen and the unexpected largely governing the department heads.

Yet this was a supposedly modern plant making a high class product and the conditions outlined prove conclusively the need for obeying the laws of production control. Let us consider these laws, one at a time, that their meaning may be clearly understood.

1. *Centralization.* Little argument should be needed to show that one function can coördinate properly, where several functions become antagonistic. One function can consider the needs of the various divisions where, if left to several, there is a tendency towards confusion and lack of coöperation, each feeling that its own needs are of paramount importance and should therefore be considered first. One function can keep the *plant ideal* constantly before it, whereas several functions mean several conflicting ideals, resulting in that game we all know so much about—"passing the buck."

2. *Scope of control.* Control to be efficient must be comprehensive and all-embracing. If the purchasing is not included in the control plans, how can efficient planning be carried on in the shops, when its efficiency is in a sense dependent on the efficiency of the purchasing function? If the engineering function is in no way guided by shop requirements, how will control function be able to plan properly, not knowing what to expect from the engineering division and when? If the tool and jig work or the making of patterns are a side issue, what basis will the control function have for scheduling foundry work or the starting of machining? If the foundry or forge shop production are not tied into the machine and assembly work, what plans can the control function make, not knowing what castings or forgings to depend upon? In other words, a control function which seeks to control simply the operations of machining and assembly, means no control at all and is always at the mercy of the shortcomings of others.

3. *Draw versus push.* Assembly and erection foremen have told me time and time again, that they could not schedule work ahead, because they did not know what was coming to them from the machines. Subsequent investigations have always borne out these statements. How could they be expected to do so, when in a guess-it-will-get-there-all-right manner, an attempt is made to start work in and through the machines, without definite reference to where it will be from time to time and where it will end up? Further, I have often seen plenty of work at machines with men working at a fair rate of efficiency, while the assembly and erection men were either hungry for parts or working on whatever they could get, but did not want, so as to keep busy. Instead of planning to keep the machines busy, with only a general idea as regards the erection, *the task should be to keep the assemblers and erection men busy on what they should have, and then fit the work in and through the machines to match this line-up.* In other words, the completion or wanted times are known factors or control constants, and the planning should work back from these constants.

In one study made of a large plant, the erection figures showed these results:

Unit	*Starting*	*Daily Productions*
1	March 25	0, 0, 26, 16, 6, 4, 8, 8, 15, 0
2	April 8	0, 2, 6, 11, 9, 4, 0, 5
3	April 12	0, 0, 3, 3, 1, 0
4	March 27	0, 5, 5, 19, 15, 5, 15, 10, 26, 18, 18, 5, 4
5	March 31	10, 12, 7, 3, 8, 12, 19, 5

It should be obvious from a study of the above figures that nothing approaching an even production now, or uniformity, or efficient working by men and gangs, or even good planning, is at all possible under such conditions. It should also be evident that the fault does not rest with the assembly department, as it assembles what it receives and, not dominating the situation from the standpoint of planning and control, can only exert an indirect influence with reference to what should be delivered to it, as well as when and the quantities. The results, however, are:

1. Disorganization of the department.
2. Breaking up and shifting of gangs.
3. Putting men familiar with one line of work on operations with which they are not so familiar.
4. Loss of production.
5. Loss of time waiting for materials when shifting gangs.
6. Increased costs of assembly.

The fault in such a case as this, can be laid to a violation of this law that work should be drawn through a shop from the erection end and not pushed through, with the drawing including all factors affecting production.

4. *Requirements.* Unless requirements are known in advance of starting work, no control over production can possibly be exercised, for the very good reason that there is no time allowed to plan properly and dispatch. In one case it was found that engineering work on the product and work on the tools and jigs, should have started months before they did start. In other words, in working back from the "completion wanted" date, to the time the important and critical items should be started, to allow for efficient manufacture and proper coördination, the elapsed time was entirely insufficient. The control function to operate properly, must know sufficiently in advance, what is to be made, the quantities and the time completions are wanted. This cannot, of course, always be done, but experience proves that it can be done much oftener than it is, as these papers will indicate.

5. *Assignment of work.* Unless sufficient work can be scheduled against machines, man and gangs, what is the sense of going to the expense of creating a control function? To go into three well-known and representative plants, where attempts were made to plan work, and find idle equipment times of 30, 40, and 50 per cent., respectively, is a sad commentary on production practice in this age of modern methods. In one of the cases—the most serious—the causes of faulty assignment were found to be:

1. Shortage of manufactured material or purchased parts.
2. Jigs and tools not in readiness.
3. Faulty design requiring experimenting in shops to correct.
4. Changes in design after manufacturing has been started.
5. Making special parts and sundries.
6. Delayed orders.
7. Changes in schedules.
8. Failure to schedule machines properly.

This law should need little argument to justify its inclusion in this list of laws. Its soundness and logic are evident, but it is one that is violated most in industry.

6. *Importance and availability.* In a plant making large gas engines, the assembly foreman once said that if he could get the parts he wanted, in the order that he knew would make for the greatest efficiency, he could get out much more production. I asked him why he could not get what he wanted when he wanted it? He stated that the foundry, forge shop and purchasing department usually gave him the things they thought he needed, or the things which seemed easiest to make, but which he did not need until toward the middle or ending of the work. As a result, I asked him to take his very complete bill of material and mark in one, two, three order, the arrangement of the parts with reference to their importance to him and that I would see if, in the future, we could not get the parts to him in the order named. He did so and it was a simple matter to rearrange the list according to importance and schedule the foundry, forge shop and purchasing department accordingly, rendering available the things necessary to efficient assembly and erection. It was simply a case of "first things first." In connection, it was found that the order of importance to the assembly end, was not the order of importance to the machining departments, nor to the foundry or the forge shop, but this phase will be treated under another heading. The aim of this law, is to furnish a manufacturing ideal, so as to lay down on the assembly floors, the proper flow of work in sequence.

7. *Operations.* Unless we know the sequence of operations, we are in no position to schedule properly the flow of parts from one place to another. If we do not know the approximate time an operation will take, we cannot say how long a machine or man will be engaged on it, and are therefore in no position to coördinate the operations and the equipment. We must also know the manner in which the work is done, so as to have a basis for time estimates and for betterments in the manner of performing. Consequently efficient control depends upon having a function at work standardizing operations, to determine sequence, method of manufacturing and the time an operation should take.

8. *Labor.* This is a law, the logic of which is generally accepted in industry but not always obeyed. If a laborer can bring material to a machinist or structural worker or molder, the higher paid skilled worker should not be called upon to do so. If an expert mechanic can shape, grind and dress tools better than the machinist or structural worker, common sense dictates that the expert mechanic should be given this work to do, that there may be uniformity and greater efficiency in what he does over what would be the case if all of the workers were allowed to take care of their own tools. The same logic applies with reference to repairing machines, inspecting work and the like.

9. *Equipment.* Equipment unstandardized, out of repair and out of balance, means the manufacture of a product at high cost, as well as delays and confusion. What a machine can do should be a known fact and not a matter of guesswork. To fail to anticipate breakdowns and make repairs out of working hours, is to court loss of production while repairing during working hours. To have equipment unbalanced, means that some machines will be congested while others will be idle for part of the time.

10. *Materials.* Materials must be just as much subject to control as labor and equipment, as it is one of the most important factors requiring coördination. There must be a knowledge of what to make, the quantities and the time in which to make them. There must be complete and up-to-the-minute knowledge of stock receipts and disbursements. There must be prompt checking of requirements against stock records. There must be a maintenance of stock margins that will insure materials being on hand when wanted. If the material situation in a plant is put under proper control, one of the stumbling blocks in the carrying out of good planning will be removed. Many an otherwise efficient production control installation has come to grief because the control over material was more fancied than real. It is, of course, fully realized that in these times there is great difficulty in efficiently controlling materials, but the methods which will be outlined in this series, will show that materials can be controlled in the average case much better than is usually done.

11. *Starting Operations.* One of the most difficult questions to answer in manufacturing is, "When should we start a certain piece of work?" In many cases coming under the writer's observation the plan was one of starting work through the foundry, forge shop and machines and then hoping and praying it would be assembled and shipped on time. The purpose of graphics is to substitute something scientific for guesswork and the prayer, through the application of this law of starting operations.

Let us analyze Figure 3 for a moment. An order is received on June 3 and is wanted on August 28, which means that 75 working days are allowed in which to make the unit or units. Now instead of *pushing* things through the shop in a haphazard manner, let us first of all observe this law of *drawing* the work through. We

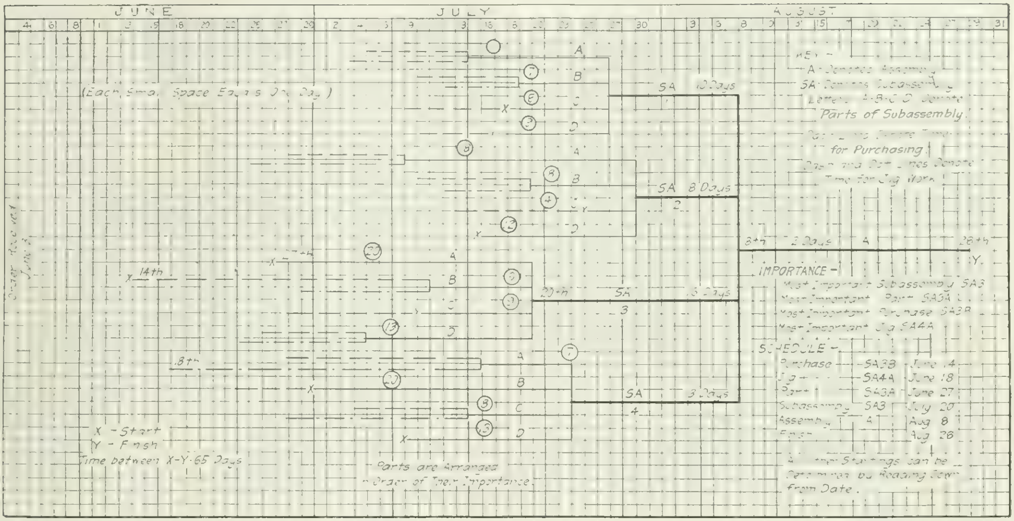


FIG. 3. MANUFACTURING CONTROL AND SCHEDULE: PURCHASING, JIG WORK, MACHINING, SUBASSEMBLY AND ASSEMBLY WORK

will first gather data as to the time it takes to do the various kinds of work necessary to complete the order. Starting back, therefore, from August 28, on graphic paper (each small space equalling one day, six days to the division), we find that final assembly will take 12 days; that there are four sub-assemblies taking 10, 8, 16 and 13 days, respectively, and that the various parts of the four sub-assemblies, take the times indicated by the circled figures on the top of each line. Going back from *Y* still further and we set down the times to make jigs and procure materials.

What do we find? The most important fact is that we must start our activities on June 14 (marked X) and that the time in which to manufacture is 65 days (June 14 to August 28). We also find (according to the law of importance) that SA1 is the most important subassembly for the assembly floor and that SA1A, SA2A, SA3A, and SA4A are the most important parts to subassemblers. The most important part from the standpoint of machining is SA3A, the most important purchase SA3B, and the most important jig SA4A. *These are the critical points.* By as much as we lose time at any of these critical points, other things being equal, by just that much must we advance the finish date. If for instance we do not get our jig work started until June 25 instead of June 14, our completion date will be September 9.

A brief study of the chart will show it to be self-explanatory and will prove conclusively the superiority of graphics over the usual method, for laying out a manufacturing program and controlling production.

12. *Succeeding operation.* By this law we can properly control the flow of operations of parts through the shops. Let us assume that part SA3A (Figure 3), taking 20 days or 200 hours, is divided as follows:

Operation	*Hours*
1	10
2	25
3	40
4	15
5	30
6	10
7	45
8	25

If we work on the assumption that we will complete the 200 hours of work by finishing the pieces at each operation, before turning the work over to the next operation, we will have a graphic record as shown in Figure 4, and can show progress by the dotted line as indicated.

Let us look at it another way, however, of releasing operations from one to another, as pieces are completed, *in cases where it is found safe to do so.* If we released one-half of operation 1, or five hours' work, to operation 2, we would be giving the latter 12½ hours' work, because the ratio of the succeeding time to the time released is 2.5 to 1, that is (25 ÷ 10). If we released 10 hours' work from operation 2 to operation 3, we would be releasing 16 hours to the latter, as the ratio of the succeeding operation to the preceding operation, is 1.6 to 1, or (40 ÷ 25). In both of these cases we release a *greater* amount of time per hour, from one operation to the next, for which reason it would be safe to schedule from 1 to 2 and from 2 to 3.

From operation 3 to 4 (40 hours to 15 hours), we have a different condition. If we released 20 hours' work from 3 to 4, it would give the latter operation only 7½ hours' work, the ratio being 0.375 to 1, or (15 ÷ 40). *In other words, if a man secured* 0.375 *hours' work from the preceding hour's work, he would be idle* 0.625 *hours while waiting for the next hour's work.* This same reasoning applies as regards releasing work from 5 to 6 and from 7 to 8, and operations 4, 6 and 8 have been marked (—) to indicate this.

On the basis of this law we can turn out the 200 hours' work referred to, in less than 20 days, as will be seen from Figure 5. Beginning from the last operation and working backward, we would plot operation 8 (25 hours) from July 19. As the relation of the time of operation 8, to operation 7, is less than 1 to 1, we should not turn any work from 7 to 8, until all of the parts have been finished at that operation, although we could release the work when approximately ¾ of the parts had been finished. Hence we would start back from the end, or near the end, of the operation—8 line and plot in the 45 hours for operation 7. Work at 6 can be turned over to 7 practically as fast as it is finished, as the ratio of 7 to 6 is greater than 1 to 1. If the reader will, therefore, trace through to operation 1, it will be seen that recognition has been given to this matter of ratio, all through the eight operations.

As will be noted by the above method of graphing, the 200 hours of work can be done in 13 days instead of 20 days.

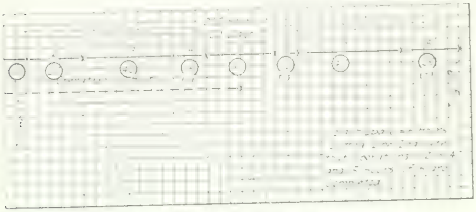


FIG. 4. A PLOTTING OF OPERATION SEQUENCE

The ratio in each case as found by this formula,

$$\frac{\text{Succeeding operation time}}{\text{Preceding operation time}} = \text{Ratio}$$

and worked out for the list of operations would be as follows for each one:

Operation	*Hours*	*Ratio*
1	10	2.5 to 1
2	25	1.0 to 1
3	40	0.375 to 1
4	15	2.0 to 1
5	30	0.33 to 1
6	10	4.5 to 1
7	45	0.55 to 1
8	25	. . .

Here is another important point in connection with this law. Multiplying the time finished at any operation by its ratio will give the available time for the next operation, through which we can always have an inventory of labor, the same as we have an inventory of materials. For instance, 2 hours completed at operation 1 multiplied by its factor (2.5 to 1) means 5 hours of work for operation 2. If we complete 7 hours' work at operation 3 and multiply it by its factor (0.375 to 1) we have, as the time against operation 4, the sum of 2.6 hours of work. This affords us an opportunity to deduct from one operation for time turned in and add to the succeeding operation, thus furnishing a continuous balance of labor to be performed against operations.

13. *Lots.* One of the factors entering into high costs of production so often met with in industry, is the practice of making a few parts of a run of parts, then tear down the machine for a rush or forgotten order, and again set up for the displaced job. By properly controlling the production, this tearing down and setting up can be reduced to a minimum, but the problem becomes one of determining the size of lots. In estimating operation times, it is usually known what the set-up times are, and it goes without saying that the greater the margin of set-up time to the time of the operations themselves, the larger should be the lot run through. When the set-up time is a small item, a small number to the lot would be consistent. This part of the law is, therefore, important in determining the size of the lots to manufacture.

On the other hand, how often have we seen valuable pieces, or heavy pieces being made in quantity, which keeps a large amount of money tied up in stock or in work-in-process. Therefore the greater the value of the material or the weight of the part, the less should be the number of the lot, making this part of the law just as important as the other.

14. *Costs.* One of the executives of a middle western plant once asked my advice on a cost problem, as regards which of two plans was the better. He stated that both the treasurer and the production manager wanted a cost system but that each one wanted a different kind of a system. The treasurer wanted a financial accounting system, which would give him everything he wanted, with which to render to his directors, a proper accounting of where money was spent, when, how, and why, but in so doing making the shops fit into his plans, instead of basing his work on manufacturing conditions. The production manager on the other hand, had a theory that he was there first of all to get out production as rapidly as possible, next to keep the expense down to a minimum, and finally to render a proper accounting for the time and cost put in on work.

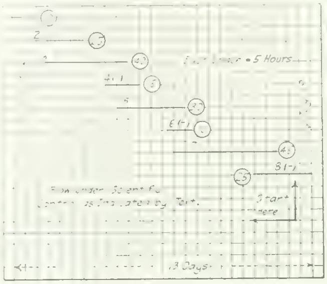


FIG. 5. PLOTTING OF OPERATION SEQUENCE FOR SEVERAL ORDERS

In other words, the one wanted financial costs, the other engineering costs; the one wanted to be a historian, delving into the past, while the other preferred to be a prophet, looking into the future; the one would make costs a prime consideration of the business, the other would make them a by-product of manufacturing.

Under "graphic production control" costs would be an engineering proposition and would be a by-product of the control mechanism, for the reason that the same records used for planning and scheduling and controlling the manufacturing, would also be used for keeping and compiling costs, leaving the rest to the accountant.

In brief, the production manager was right.

15. *Organization.* It is of the utmost importance, in providing "graphic production control," to organize the work properly. The first law outlined the value of centralization; this one considers the matter of coördination, of considering duties, functions, responsibilities and relationships. If the work is handled in a haphazard manner, with no head and tail to things, it will not be long before disorganization sets in and in the end "graphic production control" will either receive a "black eye" or be "damned with faint praise." If things are to be done, someone must do them. If things are to be done, there is a good way to do them. Therefore the things to be done, the people to do them and the manner of doing them, must be brought together and coördinated—organized, in other words. There should be nothing left to guess work or a matter of, "I didn't know" or "I understood So-and-So to say so-and-so."

A review of these laws will indicate how important "graphic production control" becomes when they are properly considered and woven into a well defined production plan. Obey the laws and results will be forthcoming. Violate them and there is a corresponding punishment as sure as the punishment we receive when we disobey the laws of the land, of health or of nature. Further, a study will indicate how important a proper consideration of law is in the treatment of production problems, instead of without reference to sound theory.

"And he went and did that which he was told."

(*To be continued*)

Time Studies for Rate Setting on Gisholt Boring Mills--IV

By Dwight V. Merrick

In the preceding article, the actual manipulation of the boring mill was treated; with illustrations showing the types of tools employed. In this installment a number of tables are given and further details of machine manipulation presented.

MR. DWIGHT V. MERRICK *served a three years' machinist appreticeship in the shop of the Southwark Foundry & Machine Company, going from there as a journeyman machinist to William Sellers & Company, where he remained for one year. He then spent two years in the engineering course at Drexel Institute. At the completion of this he went back to the Southwark Foundry & Machine Company and served as a draftsman for three years, leaving in 1898 to go with Mr. Frederick W. Taylor at the Bethlehem Steel Company. In 1901 he left Bethlehem to go to the Link-Belt Engineering Company, where he remained until 1911, devoting himself to time study work. The following two years, 1911-1913, were spent in time study in the shops of the Watertown Arsenal. From 1913 to date Mr. Merrick has devoted himself to a consulting practice in time study, giving most of his efforts to the H. H. Franklin Manufacturing Co. and to the manufacture of rifles, ammunition and machine guns.*

IN the September issue, the author described the manipulation of the boring mill for making the necessary cuts. Setting the roughing and finish-

TABLE 37

MACHINE MANIPULATION

Details of Operation	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
Start Motor—			
1. Walk to motor	0.050	0.060	0.070
2. Start motor by controller	0.060	0.060	0.060
Total time for starting motor	**0.11**	**0.12**	**0.13**
Stop Motor—			
1. Walk to controller	0.050	0.060	0.070
2. Stop motor by controller	0.030	0.030	0.030
Total time for stopping motor	**0.08**	**0.09**	**0.10**
Start Table—			
1. **Start table**	**0.04**	**0.04**	**0.04**
Stop Table—			
1. **Stop table**	**0.04**	**0.04**	**0.04**
Change Speed Gears—			
1. Walk to speed change levers	0.050	0.060	0.070
2. Change speed	0.100	0.130	0.130
3. Return to operating position	0.030	0.030	0.030
Total time to change speed	**0.18**	**0.22**	**0.23**
Change Feed Gears—			
1. Walk to feed box	0.050	0.060	0.070
2. Change position of feed box*	0.070	0.070	0.070
3 Return to operating position	0.030	0.030	0.030
Total time to change feed	**0.15**	**0.16**	**0.17**

* If both feed levers are to be manipulated, 0.04 minutes should be added to the totals for each manipulation of lever L. (Reference letters on illustration page 31, Gisholt catalog.)

Locking and Unlocking Head	Size of Machine in Inches				
	30	36	42	60	84
1. Tighten set screws to lock head against vertical movement	0.110	0.110	0.110	0 120	0.140
2. Loosen set screws to unlock head	0 110	0 110	0.110	0 120	0 140

TABLE 38

MANIPULATE TURRET HEAD—LOOSEN, REVOLVE TURRET AND TIGHTEN

Operation: Revolve turret.
Tools required: None.
Normal position of man: At end of cross rail.

	Size of Machine in Inches		
	30	36	42
	Time in Minutes		
1. Loosen clamping lever	0.03	0.03	0.03
2. Hold down locking lever	...	...	...
3. Revolve turret	0.03	0.03	...
4. Release locking lever	...	...	...
5. Raise locking pin lever	...	...	...
6. Revolve and set turret	...	...	0.94
7. Clamp locking pin lever	...	...	...
8. Tighten clamping lever	0.03	0.03	0.03
Total time for revolving turret	**0.09**	**0.09**	**0.10**

TABLE 39

MANIPULATE LEVERS TO TRAVEL RAM HEAD BY HAND FOR 30-INCH MACHINE

1. Procure wrench from tool stand	0.040	Note: A + B = C, the desired distance that the ram head is to be moved. (See Col. A below
2. Place crank on screw	0.020	
3. Crank head in or out, column B below		
4. Remove crank from screw	0.050	
Total handling time	**0.110**	

Distance of Travel in Inches	Handling Time	Time for Horizontal Travel	Total Horizontal Travel and Handling Time	Time for Vertical Travel	Total Vertical Travel and Handling Time
	A	B	C		
1	0.110	0.090	0.200	0.040	0.150
2	0.110	0.105	0.215	0.045	0.155
3	0.110	0.130	0.240	0.050	0.150
4	0.110	0.165	0.275	0.060	0.170
5	0.110	0.200	0.310	0.065	0.175
6	0.110	0.250	0.360	0.075	0.185
8	0.110	0.340	0.450	0.095	0.205
10	0.110	0.440	0.550	0.115	0.225
12	0.110	0.545	0.655	0 135	0.245
15	0 110	0.700	0.810	0.170	0 280

* Refer to crank *C* in illustration of machine with operating levers indicated. This view applies to machines of the 42-inch size and larger

ing tools, removing them from tool post, and the methods employed were all taken up. The succeeding operations and detailed times for calipering the work are now given in the following pages.

TABLE 40
MANIPULATE LEVERS TO RAPID TRAVEL RAM HEAD BY POWER FOR 36, 42, 60 AND 84-INCH MACHINES
REFER TO ILLUSTRATIONS OF MACHINE WITH OPERATING HANDLES INDICATED

1. Grasp handle F, engage clutch....	0.014	Note: A + B = C, the desired distance the ram head is to be moved.
2. Start rapid travel handle E.......	0.008	
3. Engage trip lever..................	0.008	
4. Rapid travel, see column B below.		
5. Stop travel, throw out three levers	0.030	
Total manipulation time	0.60	(See column A below)

36-Inch Machine

Distance of Travel in Miles	A Manipulating Time	B Travel Time Horizontal or Vertical	C Total Rapid Travel Time
1	0.060	0.031	0.091
2	0.060	0.062	0.122
3	0.060	0.093	0.153
4	0.060	0.124	0.184
5	0.060	0.155	0.215
6	0.060	0.186	0.246
8	0.060	0.248	0.308
10	0.060	0.310	0.370
12	0.060	0.372	0.432
16	0.060	0.496	0.556

42-Inch Machine

Distance of Travel in Miles	A Manipulating Time	B Travel Time Horizontal or Vertical	C Total Rapid Travel Time
1	0.060	0.018	0.078
2	0.060	0.037	0.097
3	0.060	0.055	0.115
4	0.060	0.073	0.133
5	0.060	0.092	0.152
6	0.060	0.110	0.170
8	0.060	0.147	0.207
10	0.060	0.183	0.243
12	0.060	0.220	0.280
16	0.060	0.293	0.353
20	0.060	0.367	0.427

60-Inch Machine

Distance of Travel in Miles	A Manipulating Time	B Travel Time Horizontal or Vertical	C Total Rapid Travel Time
3	0.060	0.050	0.110
4	0.060	0.066	0.126
5	0.060	0.083	0.143
6	0.060	0.100	0.160
8	0.060	0.133	0.193
10	0.060	0.167	0.227
12	0.060	0.200	0.260
16	0.060	0.267	0.327
20	0.060	0.333	0.393
24	0.060	0.400	0.460

84-Inch Machine

Distance of Travel in Miles	A Manipulating Time	B Travel Time Horizontal or Vertical	C Total Rapid Travel Time
3	0.060	0.050	0.110
4	0.060	0.060	0.126
5	0.060	0.083	0.143
6	0.060	0.100	0.160
8	0.060	0.133	0.193
10	0.060	0.167	0.227
12	0.060	0.200	0.260
16	0.060	0.267	0.327
20	0.060	0.333	0.393
24	0.060	0.400	0.460
32	0.060	0.534	0.594
40	0.060	0.666	0.726

If direction of travel is changed, 0.014 minutes should be added to the above travel times.

Example: If on a 36-inch machine the head is to be moved 12 inches horizontally and 6 inches vertically, the time for horizontal travel would be 0.432 minutes and for the vertical travel 0.106 plus 0.014 equals 0.120 minutes.

Calipering, gaging, etc., in fact all kinds of measuring can be classified under the same head and the different methods and instruments that are used to measure are very numerous, no attempt will be made to enumerate them. A table is given for the setting and trying of the ordinary hand and beam calipers.

The table for trying calipers goes on the supposition that when a trial is made, the calipers are carried to the machine during the cut and held in the hand while the machine is running, therefore no time is allowed to take the calipers to and from the machine.

Operation: Set calipers to scale.

Tools: Hand calipers up to 25 inches, beam calipers for larger dimensions and graduated scale.

TABLE 41
SETTING CALIPERS TO SCALE

Details of Operation	Dimensions Calipers are Set To, in Inches								
	5	10	15	20	25	30	36	40	45
	Time in Minutes								
1. Pick up and take calipers 12 feet						0.10	0.10	0.10	0.10
2. Set calipers by steel scale	0.23	0.24	0.27	0.32	0.37	0.44	0.52	0.64	0.72
3. Return calipers to stand 12 feet away						0.10	0.10	0.10	0.10
Total time to set calipers........	0.23	0.24	0.27	0.32	0.37	0.64	0.72	0.84	0.92

Note: Up to 15 inches the calipers and scale are held in the hands above 15 inches and up to 25 inches the scale is laid flat on the stand or machine table; up to 25 inches hand calipers are used. Above 25 inches beam calipers are used and is is supposed that a platen of some kind is at hand within 12 feet, where a scale of sufficient length can be laid flat t!set the beam calipers for dimensions greater than 25 inches.

MANIPULATE MACHINE TO SET TOOL FOR DEPTH AND START CUT

The time required for starting a cut on any piece of work depends upon several factors, among them being the diameter of the piece, the shape of the piece, the size and shape of the tool, the nature of the material and quality (hardness or difficulty in cutting) of the material. These factors are accounted for by considering that the length of run of the tool, that is, the distance that the tool must traverse across the piece that is being machined, is somewhat longer than the actual length of the piece. This addition to the length of run ranges from ¼ to ½ inch, depending upon circumstances, and the allowances for different conditions will be given in a subsequent set of tables.

There are however certain other elements connected with the setting and starting of cuts for which definite time allowance can be made. These are calipering, starting and stopping the table. The sequence of the elements and the allowances that are made for them either in time or length of run are given in Tables 46 to 53-B.

TABLE 42
TRY CALIPERS ON WORK

Operation: Try calipers on work in a horizontal position.
Tools: Calipers.

Details of Operation	Dimensions Calipers are Set To, in Inches								
	5	10	15	20	25	30	35	40	45
	Time in Minutes								
1. Trying calipers on roughing cuts: **Total time.....**	0.19	0.19	0.20	0.21	0.22	0.23	0.25	0.28	0.32
2. Trying calipers on finishing cuts: **Total time..**	0.19	0.19	0.21	0.22	0.25	0.28	0.32	0.36	0.41

Note: In trying diameter of cuts it is supposed that the operator takes the calipers to the machine, stops the machine and then tries as the calipers on the cut, setting the cut deeper or shallower or allowing it to remain as it is, as required.

The time required for calipering is a function of the diameter of the work. In compiling the tables for this operation it was discovered that certain items on large diameters ran smaller than the same items on smaller diameters. To counterbalance this seeming discrepancy there were other items that act in the opposite direction. In consequence there was very little difference between the total times for calipering on the large diameters and on the smaller ones, and the percentage of difference of time was so small that no account need be made of it. To simplify matters, however, two-thirds of the diameter of the table has been chosen as the dimension upon which to base the tables for calipering as the usual run of work is about that size for each size of mill.

TABLE 43
MANIPULATE MACHINE TO SET ROUND NOSE ROUGHING TOOLS FOR DEPTH, AND START FIRST CUT ON OUTSIDE DIAMETER

REFER TO ILLUSTRATION WITH TABLE 25

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over from end of rail (from normal position)	0.31	0.246	0.207	0.227	0.293
2. Rapid travel head down	0.17	0.215	0.170	0.193	0.26
3. Start table	0.04	0.04	0.94	0.04	0.04
4. Set tool into work	0.18	0.19	0.21	0.26	0.35
5. ROUGH TURN for calipering (stop machine)	*	*	†	‡	¶
6. Caliper (*)	0.21	0.22	0.23	0.28	0.42
7. Start table	0.04	0.04	0.04	0.04	0.04
8. Reset tool into work	0.17	0.175	0.18	0.20	0.25
9. ROUGH TURN for calipering (stop machine)	*	*	†	‡	¶
10. Caliper*	0.21	0.22	0.23	0.28	0.42
11. Start table			0.04	0.04	0.94
12. Reset tool into work or out.			0.18	0.20	0.25
13. ROUGH TURN for calipering (stop machine)			†	‡	¶
14. Caliper cut			0.23	0.28	0.42
15. Start table	0.04	0.04	0.04	0.04	0.04
16. Mesh feed gears	0.08				
17. ROUGH TURN					
18. Rapid travel head up	0.185	0.308	0.243	0.293	0.393
19. Rapid travel head back to end of rail normal	0.31	0.246	0.207	0.227	0.293
Total time to set and start first cut on outside diameter	**1.91**	**1.910**	**2.25**	**2.60**	**3.50**

* Length of run, ¼ inch.
† Length of run, 5/16 inch.
‡ Length of run, ⅜ inch.
¶ Length of run, ½ inch.

Note B: The time for setting tools for depth, for all first cuts, includes the time to move the ram from the normal position at the end of the rail and when the cut has been completed, to move it back again When there are additional cuts to be made, the time for these includes the time to move the ram from the point of the finish of the first cut to the position of the second and when it is completed, move it back to where the cut was started.

It is assumed in the above table that the piece is two-thirds of the diameter the machine table, namely, 20 inches for 30-inch machine; 24 inches for 36-inch; 28 inches for 60-inch; 40 inches for 60-inch; and 56 inches for 84-inch machine. The time for calipering and the diameter to catch the [illegible] rapid traveled to is based on the above

These diameters are about the average for the machines. Diameters verying from these would differ a little in time in the total but the percentage of difference would be so small that no notice need be taken of it.

The down travel used for 30-inch machine is 4 inches; for 36-inch is 5 inches; for 42-inch is 6 inches; for 60 inch is 8 inches and for 84-inch is 12 inches. Rapid travel [illegible] length plus the width of the piece [illegible] allowance for 30-inch [illegible] 2 inches for [illegible] inches for [illegible] inches for [illegible] inch 6 inches, and for 84-inch 8 inches.

In preparing for the operation of calipering, a surface is turned on the work of sufficient length to permit of calipering, the machine is stopped and the work is calipered. The necessary adjustment of the tool is made to obtain the right dimension and the work is again turned and calipered. With roughing tools on machines of the 36-inch size, two such trials are usually sufficient to catch the correct diameter; on larger machines three trials are usually enough. With finishing tools two trials are considered sufficient for all sizes of machines. These numbers of trials are the basis on which the tables have been prepared.

TABLE 43-A
SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET ROUND NOSE ROUGHING TOOL FOR DEPTH AND START FIRST CUT ON OUTSIDE DIAMETER AND LOOSEN AND REMOVE TOOL—RIGHT-HAND HEAD

Refer to illustration with Table 25.

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Set and tighten tool in tool post, Table 25	0.275	0.352	0.365	0.400	0.43
2. Set tool for depth and start first cut on outside diameter, Table 43	1.940	1.940	2.250	2.60	3.50
3. Loosen and remove tool from tool post, Table 33	0.190	0.245	.260	0.280	0.31
Total time	**2.40**	**2.50**	**2.90**	**3.3**	**4.2**

Refer to Note B under Table 4.

Throughout the tables no time has been allowed for stopping the machine. This time is included in the time after rough turning a space necessary for calipering, inasmuch as the tool continues to remove metal until the machine is stopped. Neither has any time been allowed for disengaging the feed and run-

TABLE 43-B
SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOL FOR DEPTH AND START FIRST CUT ON OUTSIDE DIAMETER AND LOOSEN AND REMOVE TOOL—LEFT-HAND HEAD

Refer to illustration with Table 25.

Details of Operation	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Set and tighten tool in tool post, Table 29	.461	.51	.59
2. Set tool for depth and start first cut on outside diameter, Table 43	2.250	2.60	3.50
3. Loosen and remove tool from tool post, Table 33	.356	.39	.47
Total time	**3.10**	**3.50**	**4.60**

Refer to Note B under Table 43.

ning the tool back as a separate operation after calipering. This item is included in the item "reset tool into work." When the proper diameter has been caught the feed is engaged and the machine operation proper begins.

It is to be borne in mind that the tables given are not to be used for setting tools for all turning jobs on boring mills of the sizes noted. They are rather data on which instruction cards should be based. For work which varies slightly in size from that on which the tables are based times should be fixed from the tables for the fundamental operations of the job in question.

TABLE 43-C
MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOLS FOR DEPTH, AND START ADDITIONAL CUT IN A DIFFERENT PLANE ON THE OUTSIDE DIAMETER

Refer to illustration with Table 25.

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Length of Travel of Head in Inches				
	3	3	4	6	8
	Time in Minutes				
1. Rapid travel head, to set next cut	0.16	0.16	0.133	0.16	0.193
2. Start table	0.04	0.04	0.04	0.04	0.04
3. Set tool into work	0.18	0.19	0.21	0.26	0.34
4. ROUGH TURN piece or calipering (stop machine)	*	*	†	‡	¶
5. Caliper	0.21	0.22	0.23	0.28	0.42
6. Start table	0.04	0.04	0.04	0.04	0.04
7. Reset tool into work	0.17	0.175	0.18	0.20	0.25
8. ROUGH TURN piece for calipering (stop machine)	*	*	†	‡	¶
9. Caliper	0.21	0.22	0.23	0.28	0.42
10. Start table			0.04	0.04	0.04
11. Reset tool into work			0.18	0.20	0.25
12. ROUGH TURN piece for calipering (stop machine)			†	‡	¶
13. Caliper			0.23	0.28	0.42
14. Start table	0.04	0.04	0.04	0.04	0.04
15. Mesh feed gears (on 30-inch only)	0.08				
16. ROUGH TURN					
17. Rapid travel head, to start of item 1	0.16	0.16	0.133	0.16	0.193
Total time to set and start additional cuts on outside diameter	**1.29**	**1.25**	**1.66**	**1.96**	**2.65**

* Length of run, ¼ inch.

† Length of run, 5/16 inch.

‡ Length of run, ⅜ inch.

¶ Length of run, ½ inch.

Note: Additional cuts are assumed to be made before the head has been brought back to its normal position at the end of the rail. The rapid travel of the head is only to bring the tool into position to start the cut. The necessary movement of the head on the average is about the factor of 0.01 multiplied by the size of the machine.

In this table, as well as in Table 41, three trials are allowed the operator for all sizes of machines, except the 30 and 36-inch to set the tool to the correct diameter. This is really not necessary for expert workmen, especially for duplicate work in large quantities. Tables can be made up omitting items from 9 to 13, inclusive.

Refer to Note B under Table 43.

It will be noted that the tables for "setting tools for depth to start cut" are made up in several forms, that is for the first cut and then for additional cuts. In the table for the first cut all the time that is re-

TABLE 43-D
MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOLS FOR DEPTH AND START ADDITIONAL CUT ON OUTSIDE DIAMETER IN THE SAME PLANE (MOVING HEAD DOWN TO NEXT CUT WITHOUT CHANGING THE DIAMETER SETTING)

Refer to illustration with Table 25.

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Length of Travel of Head in Inches				
	3	3.5	4	6	8
	Time in Minutes				
1. Travel head down	0.16	0.16	0.133	0.16	0.193
2. Start table	0.04	0.04	0.04	0.04	0.04
3. Mesh feed gear (on 30-inch only)	0.08				
4. ROUGH TURN					
5. Travel head, to start item 1	0.16	0.16	0.133	0.16	0.193
Total time to set and start additional cut on outside diameter in the same plane	**0.44**	**0.36**	**0.31**	**0.34**	**0.43**

Note: It is assumed that after a cut has been made, that the machine table has been brought to a stop. No time is ever allowed to bring the table to stop, as this is done during the cut; the time is taken care of in this item.

TABLE 44
MANIPULATING MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON OUTSIDE DIAMETER

Refer to illustration with Table 27.

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over from normal position at end of rail	0.31	0.246	0.207	0.227	0.293
2. Rapid travel head downward	0.17	0.215	0.170	0.193	0.260
3. Start table	0.040	0.040	0.040	0.040	0.040
4. Set tool into work	0.150	0.160	0.170	0.200	0.240
5. FINISH TURN piece for calipering	*	*	†	‡	¶
6. Caliper cut (see Note *)	0.220	0.250	0.270	0.360	0.470
7. Start table	0.040	0.040	0.040	0.040	0.040
8. Reset tool into work	0.150	0.050	0.160	0.180	0.210
9. FINISH TURN piece for calipering	*	*	†	‡	¶
10. Caliper cut (see Note *)	0.220	0.250	0.270	0.360	0.470
11. Start table	0.040	0.040	0.040	0.040	0.040
12. Mesh feed gear (30-inch machine only)	0.08				
13. Rapid travel head up	0.185	0.308	0.243	0.293	0.393
14. Rapid travel head back to normal	0.31	0.246	0.207	0.227	0.293
Total time to set tool to depth	**1.92**	**1.95**	**1.82**	**2.16**	**2.75**

* Length of run, ⅜ inch.

† Length of run, 7/16 inch.

‡ Length of run, ½ inch.

¶ Length of run, ⅝ inch.

Note: The times for calipering given here are based on a piece whose diameter is two-thirds that of the table.

quired to bring the head over from the normal position, that is, from the end of the rail, and run it back after the cut has been made is taken care of. In the tables for the additional cuts time is allowed for the movement of the head to bring the tool into position to start the next cut. After this cut has been made an allowance is also made to bring the head back where it was when the cut was started. Tables split up in this manner are of great assistance in simplifying the writing of instruction cards. This matter will be referred to again in the description of how to use the tables in writing instruction cards and in pre-determining the proper time to do a piece of work.

Table 44-A

SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON OUTSIDE DIAMETER AND LOOSEN AND REMOVE TOOL—RIGHT-HAND HEAD

Refer to Illustration with Table 27

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Set and tighten tool in tool post, Table 27	1.105	1.260	1.290	1.385	1.50
2. Set tool for depth and start first cut on outside diameter, Table 44	1.915	1.945	1.817	2.160	2.740
3. Loosen and remove tool from tool post, Table 33........	0.19	0.245	0.260	0.280	0.310
Total time	**3.22**	**3.45**	**3.37**	**3.83**	**4.55**

Refer to Note B under Table 43.

It is obvious that if a single cut is made the time for the first cut would be allowed for in the tables for the first cut, and if there are more than one cut the time for the cuts following the first will be found in the tables for additional cuts. The additional cut tables are usually made up in two forms: the first form is where the operation for the additional cuts differs from the setting and starting of the first only in the movement of the head, as the distance of travel is only over to the place where the additional cut or cuts are to be started. In the second form the time for the additional cut is practically an allowance to move the head over to the new position to start a cut, but where no change is to be made in the dimension of the piece.

Table 44-B

SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON OUTSIDE DIAMETER AND LOOSEN AND REMOVE TOOL—LEFT-HAND HEAD

Refer to Illustration with Table 27

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Set and tighten tool in tool post, Table 31............	These machines have but one head		1.386	1.494	1.66
2. Set tool for depth and start first cut on outside diameter, Table 44................			1.817	2.160	2.749
3. Loosen and remove tool from tool post, Table 35........			.356	.390	.47
Total time			**3.60**	**4.04**	**4.88**

Refer to Note B under Table 43.

Table 44-C

MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUTS IN A DIFFERENT PLANE ON THE OUTSIDE DIAMETER

Refer to Illustration with Table 27

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head to set next cut......................	0.16	0.16	0.133	0.16	0.193
2. Start table	0.04	0.04	0.04	0.04	0.04
3. Set tool into work.........	0.15	0.16	0.17	0.20	0.24
4. FINISH TURN piece for calipering					
5. Caliper.....................	0.22	0.25	0.27	0.36	0.47
6. Start table	0.04	0.04	0.04	0.04	0.04
7. Reset tool into work........	0.15	0.15	0.16	0.18	0.21
8. FINISH TURN piece for calipering					
9. Caliper cut.................	0.22	0.25	0.27	0.36	0.24
10. Start table.........	0.04	0.04	0.04	0.04	0.04
11. Mesh feed gears (only 30-in. machine)	0.08				
12. Finish turn					
13. Rapid travel head to start of item 1	0.16	0.16	0.133	0.16	0.193
Total time to set and start cut	**1.26**	**1.35**	**1.27**	**0.15**	**0.67**

Refer to Note B under Table 43.

In setting and starting the first cut, the first additional cut manipulation is necessary until the proper dimension is obtained in setting the tool, then the feed is turned in and the cut is started.

Table 44-D

MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUT ON OUTSIDE DIAMETER IN THE SAME PLANE (MOVING HEAD DOWN WITHOUT CHANGING THE DIAMETER SETTING)

Refer to Illustration with Table 27

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Travel head down	0.16	0.16	0.133	0.16	0.193
2. Start table.......	0.04	0.04	0.04	0.04	0.04
3. Mesh feed gear (on 30-inch only	0.08				
4. FINISH TURN........					
5. Travel head. to start of item 1.	0.16	0.16	0.133	0.16	0.193
Total time to set and start additional cut on outside diameter in the same plane.................	**0.44**	**0.36**	**0.31**	**0.31**	**0.43**

Refer to Note B under Table 43.

Of course these tables only cover a small portion, and the most elementary forms of tools, of the possible combinations that can be made up from the elementary tabulated times. In some shops it may be found that other combinations can be useful. These, of course, are easily put together.

A careful study of the tables themselves will show better than any possible description just how they are built up and arranged. It is strongly advised that before any use is made of these tables that they be most thoroughly studied.

TABLE 45

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK

REFER TO ILLUSTRATION WITH TABLE 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over	[illegible]	0.246	0.207	0.227	0.29
2. Rapid travel head down [illegible]	0.17	0.215	0.17	0.193	0.26
3. Set tool for depth†	0.36	0.39	0.42	0.50	0.61
4. Tighten set screw that tightens vertical slide to head	0.11	0.11	0.11	0.12	0.12
5. Start table	0.04	0.04	0.04	0.04	0.04
6. Mesh feed gears (on 30-inch machine only)..........	0.08				
7. Throw feed clutch in		0.05	0.05	0.06	0.07
8. ROUGH FACE (stop mach					
9. Loosen set screw that tightens vertical slide	0.11	0.11	0.11	0.12	0.14
10. Rapid travel head up......	0.17	0.215	0.17	0.193	0.26
11. Rapid travel head over to end of rail	0.355	0.338	0.28	0.327	0.43
Total time to set and start cut	1.78	1.72	1.56	1.78	2.21

Refer to Note B under Table 43.

The 30-inch and 36-inch machines, the travel of the head and ram is done by cranking by hand. The cranking is a longer operation on the 30-inch machine than on the 36-inch. On the 42-inch and up the travel is by power. This accounts for the longer time of operation on the smaller machines.

MANIPULATING MACHINE TO SET TOOL TO DEPTH IN A TURRET TOOL POST

A turret tool post for the ordinary line of work is only found on machines up to and including the 42-inch size. For certain classes of work the turning tools remain in the turret for the whole time. When work has been clamped to the table it is only necessary to manipulate the turret to bring the tool into position for the cut that it is to make. The head is then rapid travelled over and down to a position to start the cut. The cut is started and the tool is set to depth, and the various operations of measuring are performed until the desired dimension is obtained, after which the reading on the micrometer index dial is noted if duplicate pieces are to be machined. At the com-

TABLE 45-A

SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK, LOOSEN AND REMOVE TOOL - RIGHT-HAND HEAD

REFER TO ILLUSTRATION WITH TABLE 26

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Set and tighten tool on tool post, Table 26.........	.275	.282	[illegible]	[illegible]	[illegible]
2. Set tool for depth and start first cut on face of work, Table 45...............	1.775	1.714	[illegible]	1.780	2.243
3. Loosen and remove tool from tool post, Table 34.....	190	[illegible]	[illegible]	.23	.26
Total time	2.24	2.19	2.06	2.31	2.86

Refer to Note B under Table 43.

TABLE 45-B

SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK, LOOSEN AND REMOVE TOOL LEFT-HAND HEAD

REFER TO ILLUSTRATION WITH TABLE 26

Details of Operation	Size of Machine in Inches		
	42	60	84
	Time in Minutes		
1. Set and tighten tool in tool post, Table 30	.391	.440	.52
2. Set tool for depth and start cut on face of work, Table 45	1.557	1.780	2.243
3. Loosen and remove tool from tool post, Table 36	.306	.34	.42
Total time	2.25	2.56	3.18

Refer to Note B under Table 43.

TABLE 4-5C

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOLS FOR DEPTH AND START ADDITIONAL CUT IN A DIFFERENT PLANE OR SURFACE ON FACE OF WORK

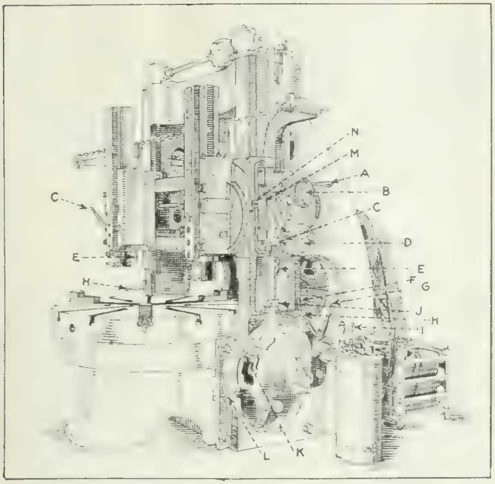
REFER TO ILLUSTRATION WITH TABLE 26

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Length of Travel of Head in Inches				
	3	3.5	4	6	8
	Time in Minutes				
1. Rapid travel head over†	0.24	0.16	0.133	0.16	0.193
2. Set tool for depth.*........	0.36	0.39	0.42	0.50	0.61
3. Tighten set screw that tightens vertical slide to head...	0.11	0.11	0.11	0.12	0.14
4. Start table .	0.04	0.04	0.04	0.04	0.04
5. Mesh feed gears (on 30-inch machine only)...........	0.08				
6. Throw feed clutch in		0.05	0.05	0.06	0.07
7. ROUGH FACE (stop mach)					
8. Loosen set screw that tightens vertical slide	0.11	0.11	0.11	0.12	0.14
9. Rapid travel head up......	0.17	0.215	0.17	0.193	0.26
10. Rapid travel head back† ..	0.24	0.16	0.133	0.16	0.193
Total time to set and start cut	1.35	1.24	1.17	1.35	1.65

Refer to Note B under Table 43.

† In the 30-inch and 36-inch machines the travel of the head and ram is done by cranking by hand. The cranking is a longer operation on the 30-inch machine than on the 36-inch. On the 42-inch machine and up, the travel is by power. This accounts for the longer time in operation on the smaller machines.

* By measuring with a scale from table of machine or by using a surface that has been set for height.



GISHOLT BORING MILL SHOWING OPERATING LEVERS

pletion of the cut the head is rapid travelled up and back. If cuts are to be made with the other tools the necessary manipulation of the turret is done to bring the next tool into position. The head is then rapid travelled over and down to a position to start the cut according to the method shown by the table for the desired kind of cut. If duplicate pieces are to be made the reading on the micrometer index dial is noted. At the completion of the cut the head is rapid travelled back.

Table 46

MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK. SET DEPTH OF CUT TO JUST FINISH ON THE FACE

Refer to Illustration with Table 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over*	0.38	0.246	0.207	0.227	0.293
2. Rapid travel head downward	0.17	0.215	0.17	0.193	0.26
3. Set tool for depth	0.12	0.12	0.13	0.14	0.17
4. Tighten set screw that tightens vertical slide to head	0.11	0.11	0.11	0.12	0.14
5. Start table	0.04	0.04	0.04	0.04	0.04
6. Mesh feed gears (on 30-inch machine only	0.08				
7. Throw feed clutch in		0.05	0.05	0.06	0.07
8. FINISH FACE .					
9. Loosen set screw that tightens vertical slide	0.11	0.11	0.11	0.12	0.14
10. Rapid travel head up	0.17	0.215	0.17	0.093	0.26
11. Rapid travel head over to end of rail	0.355	0.338	0.28	0.327	0.43
Total time	**1.51**	**1.44**	**1.27**	**1.32**	**1.80**

* Refer to Note † under Table 45-C.
Refer to Note B under Table 43.

This procedure is continued until all of the tools in the heads are set if this is required. It is possible to set the same tool to several different dimensions by noting the readings on the micrometer index dial.

For cuts on duplicate pieces where the readings on the micrometer index dial have been noted the times are considerably shorter.

In a number of cases it is not necessary to allow time for setting and tightening tools in the turret tool posts and for removing them as this may be done while the cut is in progress. However, this practice is often accompanied with some danger and the saving of time does not warrant the risk.

Table 46-A

SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK—RIGHT-HAND HEAD

Refer to Illustration with Table 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Set and tighten tool in tool post, Table 28	1.105	1.120	1.15	1.245	1.360
2. Set tool for depth and start first cut on face of work, Table 46	1.535	1.444	1.267	1.32	1.803
3. Loosen and remove tool from tool post, Table 34	.190	.195	.210	.23	.26
Total time	**2.83**	**2.76**	**2.63**	**2.80**	**3.42**

Refer to Note B under Table 43.

On all facing cuts there is a clamping nut to tighten the ram, or up and down slide, after the desired dimension has been set. This nut must be loosened after the cut has been made.

Table 46-B

SET AND TIGHTEN TOOL IN TOOL POST, MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK—LEFT-HAND HEAD

Refer to Illustration with Table 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Set and tighten tool in tool post, Table 32	These machines have but one head		1.246	1.355	1.52
2. Set tool for depth and start first cut on face of work, Table 46			1.267	1.320	1.803
3. Loosen and remove tool from tool post, Table 36			.306	.34	.42
Total time			**2.82**	**3.01**	**3.74**

Refer to Note B under Table 43.

Manipulating Machine to Change Feeds and Speeds and Control the Mill

Various combinations of feeds, speeds, etc., are obtained by manipulation of the levers shown on this page. These are for the operating tests at either end of the cross rail which are the normal positions for the workman in the following tabulation:

The functions of the several levers are as follows:

A. This lever controls the raising and lowering the cross rail, see page 295. It is used in connection with lever I. See Table 3, page 36, of the July issue.

E.E. These levers are used to engage the feed for either the vertical or horizontal heads. They are also used for reversing and stopping the feeds.

TABLE 46-C
MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUT IN DIFFERENT PLANES OR SURFACES ON FACE OF WORK. (SET DEPTH TO JUST FINISH ON THE FACE)

REFER TO ILLUSTRATION WITH TABLE 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over	0 24	0.16	0.133	0.16	0.193
2. Set tool for depth	0.12	0.12	0.13	0.14	0.17
3. Tighten set screw that tightens vertical slide to head...	0.11	0.11	0.11	0.12	0.14
4. Start table....	0 04	0 04	0 04	0.04	0.04
5. Mesh feed gears (on 30-inch machine only)............	0.08				
6. Throw feed clutch in		0 05	0.05	0.06	0 07
7. FINISH FACE (stop machine					....
8 Loosen set screw that tightens vertical slide	0.11	0.11	0.11	0.12	0.14
9. Rapid travel head up........	0.17	0.215	0.17	0.193	0 26
Total time	**0.87**	**0.81**	**0.74**	**0.83**	**0.98**

Refer to Note B under Table 43.

F. This lever controls the table speeds through sliding gears on the headstock. The three positions of the lever make available three speeds. The forward position gives the medium table speed; the middle position gives the fast speed; the back position gives the slow speed, see Table 25.

TABLE 46-D
MANIPULATING MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUT IN THE SAME PLANE ON FACE OF WORK (MOVING HEAD OVER TO ANOTHER SURFACE)

REFER TO ILLUSTRATION WITH TABLE 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over*	0.24	0.16	0.133	0.16	0.193
2. Start table................	0 04	0 04	0.04	0.04	0 04
3. Mesh feed gears (on 30-inch machine only)	0 08				
4. Throw feed clutch in		0 05	0.05	0.06	0.07
5. FINISH FACE (stop machine).					
6. Rapid travel head back*	0 24	0.16	0.133	0.16	0.193
Total time	**0.60**	**0.41**	**0.36**	**0.42**	**0.50**

*Refer to Note †under Table 45-C.
Refer to Note Bunder Table 43

G. This lever controls the table movement. After the motor has been started the table may be started, stopped or moved a fractional part of a revolution by manipulating this lever. See Table 25.

K.L. These are the feed change handles. There are five positions for lever K, while lever L, which operates the back gears has only two positions. See Table 25.

TABLE 46-E
MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK. (SET DEPTH OF CUT BY MICROMETER INDEX DIAL)

REFER TO ILLUSTRATION WITH TABLE 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over:† ..	0.38	0.246	0.207	0.227	0.293
2. Rapid travel head downward	0.17	0.215	0.17	0.193	0.26
3. Set tool to depth by micrometer index dial	0.20	0.20	0.20	0.21	0.24
4. Tighten set screw that tightens vertical slide to head.	0.11	0.11	0.11	0.12	0.14
5. Start table................	0.04	0.04	0.04	0.04	0 04
6. Mesh feed gears (on 30-inch machine only)	0.08				
7. Throw feed clutch in.		0.05	0.05	0.06	0.07
8. FINISH FACE (stop machine	..	....	..	.....	...
9. Loosen set screw that tightens vertical slide..........	0.11	0.11	0.11	0.12	0.14
10. Rapid travel head up.......	0.17	0.215	0.17	0.193	0.26
11. Rapid travel head over to end of rail	0.355	0.338	0.28	0.327	0.43
Total time to set and start cut	**1.62**	**1.52**	**1.34**	**1.39**	**1.85**

* Refer to Note † under Table 45-C.
Refer to Note B under Table 43.

H.H. These are the rapid traverse levers for controlling all movements of the head. Manipulating either one automatically disengages all feeds and moves the heads rapidly in the desired direction. Releasing the levers, stops the rapid travel and

TABLE 46-F
MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUT IN A DIFFERENT PLANE OR SURFACE ON FACE OF WORK. (SET DEPTH OF CUT BY MICROMETER INDEX DIAL)

REFER TO ILLUSTRATION WITH TABLE 28

Details of Operation	Size of Machine in Inches				
	30	36	42	60	84
	Time in Minutes				
1. Rapid travel head over.....	0.24	0.16	0.133	0.16	0.193
2. Set tool to depth by micrometer index dial	0.20	0.20	0.20	0.21	0.24
3. Tighten set screw that tightens vertical slide to head..	0.11	0.11	0.11	0.12	0.14
4. Start table	0.04	0.04	0.04	0.04	0.04
5. Mesh feed gears (on 30-inch machine only)	0.08				
6. Throw feed clutch in		0 05	0.05	0.06	0 07
7. FINISH FACE (stop machine				....	....
8. Loosen set screw that tightens vertical slide.........	0.11	0.11	0.11	0.12	0 14
9. Rapid travel head up.......	0.17	0.215	0.17	0.193	0.26
10. Rapid travel head back.....	0.24	0.16	0.133	0.16	0.193
Total time	**1.19**	**1.05**	**0.95**	**1.06**	**1.28**

Refer to Note B under Table 43.

causes the feed to resume operating. These levers are not found on the 30- or 36-inch machines.

C.C. These are the hand cranks for moving the heads when it is not desirable or necessary to use the rapid travel machine. They supply the only means of moving the heads on the 30- and 36-inch machines. See Tables 39 and 40.

Table 47

MANIPULATING MACHINE TO SET ROUND-NOSE ROUGHING TOOL FOR DEPTH AND START FIRST CUT ON OUTSIDE DIAMETER—REVOLVE TURRET TO BRING TOOL TO POSITION

Details of Operation	Size of Machine in Inches		
	30	36	42
	Time in Minutes		
1. Loosen clamp turn turret and tighten	0.09	0.09	0.10
2. Rapid travel head over from end of rail (from normal position)......	0.31	0.246	0.207
3. Rapid travel head down............	0.17	0.215	0.170
4. Start table......................	0.40	0.04	0 04
5. Set tool into work................	0.18	0.19	0 21
6. ROUGH TURN for cliapering (stop machine)......................	*	*	†
7. Caliper (1)......................	0.21	0.22	0.23
8. Start table......................	0.04	0.04	0 04
9. Reset tool into work..............	0.17	0.175	0 18
10. ROUGH TURN for calipering (stop machine)......................	*	*	†
11. Caliper (1)......................	0.21	0.22	0.23
12. Start table......................	0.04	0.04	0 04
13. Mesh feed gears..................	0.08	....	.
14. ROUGH TURN......................	.	.	.
15. Rapid travel head up.............	0.185	0.308	0.243
16. Rapid travel head back to end of rail normal......................	0.31	0.246	0.207
Total time.	**2.03**	**2.03**	**2.35**

* Length of run, ¼ inch.

† Length of run, 5/16 inch.

Refer to Note B under Table 43.

Note: Turret tool posts are not used on machines larger than 42-inch except in special cases. The total time for manipulating machines in this table is greater than in the tables for the same kind of setting and starting cut, because there is an allowance to "loosen clamp, turn turret and tighten."

It is supposed that the other holes in the turret have tools set in them to make different kinds of cuts. It is obvious then that this arrangement does away with the changing of tools.

Additional cuts where the turret is not revolved take the times shown in the tables referred to.

B.D. These refer to the vertical and horizontal feed trip dials on either end of the rail. They automatically disengage the feed at any predetermined point and at the end of the rail or of the down slide traverse. See item 3 or Table 46E.

Table 47-A

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOL FOR DEPTH AND START ADDITIONAL CUT ON OUTSIDE DIAMETER (CUTTING TOOL IN TURRET HEAD)

Refer to Table 43-C

Table 47-B

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOLS FOR DEPTH AND START ADDITIONAL CUT ON OUTSIDE DIAMETER IN THE SAME PLANE (MOVING HEAD DOWN TO NEXT CUT WITHOUT CHANGING THE DIAMETER SETTING)

Refer to Table 43-D

M. This refers to the micrometer index dials on both feed screws.

Continual use will be made of items "starting table," "locking and unlocking head" in compiling the tables of "manipulating machines to set tool for depth and start cut." On the other hand "starting and stopping motor" and "change speed and feed gears" are not put in such use in the combined tables.

Table 48

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING OR SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON THE OUTSIDE DIAMETER, CUTTING TOOL AND SECURE IN TURRET TOOL POSTS REVOLVE TURRET TO BRING TOOL TO POSITION

Details of Operation	Size of Machine in Inches		
	30	36	42
	Time in Minutes		
1. Loosen clamp turn turret and tighten	0.09	0.09	0.10
2. Rapid travel head over from normal position	0.31	0.246	0.207
3. Rapid travel head downward.......	0.17	0.217	0.17
4. Start table.....	0.04	0.04	0.04
5. Set tool to depth by micrometer index dial............................	0.20	0.20	0.20
6. Mesh feed gears	0.08	.	
7. Throw feed clutch in	....	0.05	0.05
8. TURN—ROUGH or FINISH.	.	..	
9. Rapid travel head up..............	0.185	0.308	0.243
10. Rapid travel head over to one side..	0.31	0.246	0.207
Total time......................	**1.39**	**1.40**	**1.21**

Note: This table is to be used for repetition work. The setting of the index dial is determined when the cut is made on the first piece, and a note is made of it. For all succeeding pieces the desired diameter can be obtained without trial and calipering by setting to these readings.

Refer to Note B under Table 43.

The driving motor of the machine can be started and allowed to run continuously while the machine is in use, although it is advisable to stop it when handling and removing the work. As this time of starting and stopping will only be required once or twice for a piece it should be taken care of in the preparation allowances. The changing of speed and feed gears can be done during the machining time so no account need be taken of the time required for these movements.

Table 48-A

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING OR SQUARE-NOSE FINISHING TOOLS FOR DEPTH AND START CUT ON OUTSIDE DIAMETER IN THE SAME PLANE (MOVING HEAD DOWN WITHOUT CHANGING DIAMETER OF CUT

Refer to Tables 43-D and 44-D

Note: For additional cuts in different planes, it is necessary to have a tool in another turret post, or to have noted another setting of the index dial when the first piece was turned. In the first case, the time for setting the cut would be the same as in Table 48, for in order to turn the turret the head has to be brought out to the end of the rail, and then back again.

Though the foregoing operations cover the actual setting of the tool in the tool post, considerable manipulation of the boring mill is required before the tool can be set for depth of cut or the act of machining actually

TABLE 49

MANIPULATE MACHINE TO SET SQUARE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON OUTSIDE DIAMETER, REVOLVING TURRET TO BRING TOOL INTO POSITION

Details of Operation	Size of Machine in Inches		
	30	36	42
	Time in Minutes		
1. Loosen clamp turn turret and tighten clamp	0.09	0.09	0.10
2. Rapid travel head over from end of rail	0.31	0.246	0.207
3. Rapid travel head downward	0.17	0.215	0.17
4. Start table	0.04	0.04	0.04
5. Set tool into work	0.15	0.16	0.17
6. FINISH TURN enough to caliper			
7. Caliper out	0.22	0.25	0.27
8. Start table	0.04	0.04	0.04
9. Reset tool into work	0.15	0.15	0.16
10. FINISH TURN enough to caliper			
11. Caliper cut	0.22	0.25	0.27
12. Start table	0.04	0.04	0.04
13. Mesh feed gears	0.08		
14. FINISH TURN			
15. Rapid travel head up	0.185	0.308	0.243
16. Rapid travel over to one side	0.31	0.246	0.207
Total time to set and start cut	**2.01**	**2.04**	**2.02**

Refer to Note B under Table 43.

started. For instance, the motor of the machine has to be started or stopped, also the boring mill table, possibly the speed or the feed gears have to be changed and in all cases the turret head has to be locked or unlocked. These fundamental operations with the time required for each were listed in Table 15, on page 41 of the July issue of INDUSTRIAL MANAGEMENT, including the time for the incidental elementary acts. The turret heads also have to be manipulated prior to the starting of a cut. For boring mills of the 30, 36 and 42-inch types, the turret heads have to be loosened, revolved and tightened—unit times for which acts were given, and also the total time required for revolving the turret heads for the three types of boring mills. The ram head of 30-inch mills are moved by hand levers—see Tables 39 and 40—but the ram heads of larger types of boring mills are moved by power through the manipulation of certain levers, as mentioned.

TABLE 49-A

MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUTS IN A DIFFERENT PLANE ON THE OUTSIDE DIAMETER

REFER TO TABLE 44-C

TABLE 49-B

MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUT ON OUTSIDE DIAMETER IN THE SAME PLANE (MOVING HEAD DOWN WITHOUT CHANGING THE DIAMETER SETTING)

REFER TO TABLE 44-D

It is customary—at least on any finish cut—to caliper, gage or measure cut diameters, or other dimensions, preparatory to commencing the actual removal of metal (the working cut). This necessitates short trial cuts to provide gaging surfaces, the time to take which, for convenience, is allowed and provided for in the machining time. That is, if a cut of a certain length has to be made a suitable trial cut or series of trial cuts for measuring purposes are considered as additional to the necessary working cut and the machining time should be calculated to include the time consumed

TABLE 50

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOL FOR DEPTH AND START FIRST CUT ON FACE TOOLS HELD IN TURRET TOOL POST

Details of Operation	Size of Machine in Inches		
	30	36	42
	Time in Minutes		
1. Loosen clamp turn turret and tighten	0.09	0.09	0.10
2. Rapid travel head over†	0.38	0.246	0.207
3. Rapid travel head downward	0.17	0.215	0.17
4. Set tool for depth*	0.36	0.39	0.42
5. Tighten set screw that tightens vertical slide to head	0.11	0.11	0.11
6. Start table	0.04	0.04	0.04
7. Mesh feed gears (on 30-inch machine only)	0.08		
8. Throw feed clutch in		0.05	0.05
9. ROUGH FACE (stop machine)			
10. Loosen set screw that tightens vertical slide	0.11	0.11	0.11
11. Rapid travel head up	0.17	0.215	0.17
12. Rapid travel head over to end of rail	0.355	0.338	0.28
Total time to set and start cut	**1.86**	**1.80**	**1.657**

* By measuring with a scale from table of machine or by using a surface that has previously been set for height.

† Refer to Note † under Table 45C.

Refer to Note B under Table 43.

TABLE 50-A

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING TOOLS FOR DEPTH AND START ADDITIONAL CUT IN A DIFFERENT PLANE OR SURFACE ON FACE OF WORK

REFER TO TABLE 45-C

TABLE 51

MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START FIRST CUT ON FACE OF WORK—SET DEPTH OF CUT TO JUST FINISH ON THE FACE — REVOLVE TURRET TO BRING TOOL TO POSITION

Details of Operation	Size of Machine in Inches		
	30	36	42
	Time in Minutes		
1. Loosen clamp turn turret and tighten	0.09	0.09	0.10
2. Rapid travel head over*	0.38	0.246	0.207
3. Rapid travel head downward	0.17	0.215	0.17
4. Set tool for depth	0.12	0.12	0.13
5. Tighten set screw that tightens vertical slide to head	0.11	0.11	0.11
6. Start table	0.04	0.04	0.04
7. Mesh feed gears (on 30-inch machine only	0.08		
8. Throw feed clutch in		0.05	0.05
9. FINISH FACE			
10. Loosen set screw that tightens vertical slide	0.11	0.11	0.11
11. Rapid travel head up	0.17	0.215	0.17
12. Rapid travel head over to end of rail	0.355	0.338	0.28
Total time	**1.63**	**1.54**	**1.37**

* Refer to Note † under Table 45C.

Refer to Note B under Table 43.

for the trial cuts. The actual calipering, or gaging, may be performed by different methods and by numerous instruments, but typical of calipering time requirements are those for setting and trying of the ordinary hand and beam calipers given in Tables 41 and 42. These tables are based on the assumption that when a caliper trial is made, the calipers are carried to the machine during the machining process and held in the hand while the machine is running.

In trying (calipering) diameters of cuts it is assumed that the workman takes the calipers to the machine, stops the mill and then, with the calipers on the cut, tries setting the cut deeper or shallower or allowing it to remain as it is, as may be required.

(To be continued)

Table 51-A

MANIPULATE MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUT IN DIFFERENT PLANES OR SURFACES ON FACE OF WORK—SET DEPTH OF CUT TO JUST FINISH ON THE FACE

Refer to Table 46-C

Table 51-B

MANIPULATING MACHINE TO SET SQUARE-NOSE FINISHING TOOL FOR DEPTH AND START ADDITIONAL CUT IN THE SAME PLANE ON FACE OF WORK (MOVING HEAD OVER TO ANOTHER SURFACE)

Refer to Table 46-D

Table 52

MANIPULATE MACHINE TO SET ROUND-NOSE ROUGHING OR SQUARE-NOSE FINISHING TOOLS FOR DEPTH AND IN GENERAL ANY TOOLS USED FOR FACING WHERE THE POWER FEED IS THROWN IN—TOOLS HELD IN TURRET TOOL POST

Details of Operation	Size of Machine in Inches		
	30	36	42
	Time in Minutes		
1. Loosen clamp turn turret and tighten	0.09	0.09	0.10
2. Rapid travel head over *	0.38	0.246	0.207
3. Rapid travel head downward	0.17	0.215	0.17
4. Set tool to depth by micrometer index dial	0.20	0.20	0.20
5. Tighten set screw that tightens vertical slide to head	0.11	0.11	0.11
6. Start table	0.04	0.04	0.04
7. Mesh feed gears (on 30-inch machine only	0.08		
8. Throw feed clutch in		0.05	0.05
9. FACE ROUGH or FINISH			
10. Loosen set screw that tightens vertical slide	0.11	0.11	0.11
11. Rapid travel head up	0.17	0.215	0.17
12. Rapid travel head over to end of rail	0.355	0.338	0.28
Total time to set and start cut	**1.71**	**1.64**	**1.44**

Note: This table is to be used for repetition work. The setting of index dial is determined when the cut is made on the first piece, a note is made of it and for all succeeding pieces the desired diameter can be obtained, without trial or calipering by setting to these readings.

Note: For additional cuts in different planes, it is necessary to have a tool in another turret tool post, or to have another setting of the micrometer index dial when the first piece was faced, using Table 46F. In the first case the time for setting and starting the cut would be the same as in Table 52, for in order to turn the turret head, the head has to be brought out to the end of the rail, the turret turned and the head brought back again.

* Refer to Note † under Table 45C.

Refer to Note B under Table 43.

Workmanship and Efficiency—Discussion

By A. R. Allard

With the Westinghouse Electric & Manufacturing Company

I HAVE read the article by Mr. C. W. Starker in the July number, expressing concern as to whether modern efficiency methods were not affecting the quality of goods and workmanship. To one who has worked his way through the day-work jobbing shop, and on through the various stages to a position where he can observe all classes of mechanics, who have been trained under every known system of apprenticeship and finally are absorbed in the modern factory, there is little of warning or even interest in this hackneyed excuse of inefficiency.

Real efficiency, or rather *efficiency* which is quantitative and not descriptive, is concerned with the measuring and assuring of quality as well as quantity of work done or materials turned out. In fact efficiency is no respector of particular persons, operations, measurements, or things, but is applicable from the President, his methods and jurisdiction, down the scale to the factory sweeper.

"What of workmanship and conscientiousness in an aeroplane motor, the weight of which shall not exceed two or three pounds per horsepower, as against hundreds of pounds for the old crude steam engine, and with the life of the crew at stake for any defect in mechanism?" As I remember those old crude engines and locomotives they were built by old fellows with the "Spirit of pride in their work" cropping out so profusely that they spent hours of their time polishing cylinder heads that were exposed to the elements and the eye, instead of polishing the cylinder bores to eliminate friction.

If we had waited for pride instead of efficiency, to develop the aeroplane engine we would still be as far from flying as Noah's ark was from being a submarine.

Which would you prefer, an engine made according to modern efficiency methods with the speeds and feeds and tools required to produce quality, determined and held to standards, or a machine built where these standards are set by the mechanic who happens to work on the job with the quality regulated even partly by his pride? There is no doubt about your answer.

Getting Results from Unskilled Labor

If, as has been stated, "A decline in quality of workmanship has been noticed recently," it is probably in isolated cases or due to local conditions and is the result, not of efficiency, but the lack of it. We have at present the condition of an unparalleled dearth of skilled labor pressing upon us, and the workmanship of the employees of many industries has probably been below the former high standard when all operations and labor were performed by skilled men or highly specialized operators, yet I can see no reason to lay this at the door of modern efficiency, tagged, "Not up to specifications." To me this condition sounds the highest praise of efficiency methods, that industry has been able to proceed without faltering when handicapped so heavily. How long could the old school have stood the strain, and which is weathering the storm the better?

We cannot have too much efficiency, though there are many inefficiencies or mis-directed efforts masquerading under the name. What we need is a wider circulation of and education in the methods of applying efficiency, and do not confine this campaign to the executive forces either, give the men on the floor a measure of it. They will probably show you some faults and may suggest remedies. It is only fair that they should know the methods used to determine their tasks.

Assuredly there have been many mistakes and blunders made and the most dangerous man of all is the one who gets the efficiency "bug" and starts out with a stop watch and pencil to reform the shop men, when better judgment would suggest the elimination of the other lost motions, of which there are no doubt many, first.

Quality in Munition Manufacture

High pay on the munition work never was an inducement to make "bad conditions run to worse," as is contended, if the quality was properly controlled and safeguarded, and instead of the money incentive being a detriment as to quality it should be an incentive to hold the workmanship to a standard. Right here a little education will come in good if the men are taught to know that they receive more for a perfect shell than for one that needs repairs.

You will rarely see a set-up of tools broken through sentiment or pride or for any reason except the incentive to make extra money, and the quality is safeguarded much closer than if influenced by sentimental reasons.

By all means inspire every possible amount of pride in all work and give us the satisfaction of having done our work well. This spirit is as evident on the shell work as on any other. Each man strives to keep his name off of the defective chart and scrap record, and his ability to do so is respected and envied by the less fortunate, to the end that they study his methods and try to improve their own.

Where pride and conscientiousness are particularly evident as to quality of workmanship, you will usually find the same qualities displayed in the other activities and habits of the individual. Is not the man who is "keeping his head above water," or who is accumulating something for a rainy day more liable to be possessed of pride and conscientiousness than one who is just making ends meet by skimping or who runs a little behind each pay day?

On shell work I have heard men say, "Well we are on our feet again," or, "When we hear a knock at the door now, we are not afraid it is a collector." They are proud of being able to furnish clothing, food, and a home for their family, with probably a Victrola or maybe a "Flivver" thrown in. Do *you* not know that this pride is reflected in their work?

Undoubtedly there are workmen who cannot stand prosperity, but they are not the ones in whom you look for pride in their accomplishments. They will always spend your time just as they do their own. Give us men with pride and lots of it, but deliver us from the false pride of the fellow who is afraid of increasing his production by working a machine to its rated capacity.

In these days of complex machinery and multiplicity of parts, who should judge as to the quality when the workman rarely sees assembled the part upon which he is working, nor would he appreciate the particular requirements if he did have such opportunity.

The How of Efficiency Must Be Shown

Industrial efficiency is on a par with the filtering plant which because it gives you good water should not have its supply cut in half. Efficiency is concerned with the packing rings in the delivery pumps as well as with the chemical analysis of the water itself.

In these days of grave necessity many methods and incentives will be tried out to assure both quantity and quality. Speaking for myself, I know of no serum with which to be inoculated to assure either or both, nor do I know of a better appeal to make or a better way to safeguard both than through efficiency methods, if possible assisted by an appeal through the pay envelope.

Mr. E. St. Elmo Lewis covered the whole matter very cleverly in a past issue of Industrial Management when he summed it up as follows:

> Inspirational talks, and emotional appeals to sentiment, act like a cocktail or digestive excitant, but as one man expressed: "Creating an appetite already ravenous may be good, but giving us something to eat is more important." I find most men want the better, bigger things of life but they want to be shown How to Get the Better Things. It is an excellent thing to give a man an ideal, but it is just as practical to show him how to intelligently and effectively progress toward that ideal. This demand for a program of action calls for intelligent management—it calls for scientific management.

We are in this war to win and production was never needed so badly as now. Men are putting every other thing aside with this one thought and purpose uppermost in their minds. With conditions as they are before us and the war to be won by the side holding the last narrow margin of production of war materials, any suggestion that might retard production when it is needed so badly or which befogs an already clouded atmosphere should be promptly rejected as a pro-German suggestion. At least only slackers will stop NOW to heed them.

If your home catches fire you want the firemen to turn the water on it. You will not ask them to sterilize the water first, will you? If the house is contaminated you will renovate and fumigate it. If it burns down the contamination will not hurt.

And so with scientific management and efficiency—they will put the fire out if you do not stop to sterilize them.

Raising the question of quality of workmanship as affected by efficiency is as sensible as worrying about running water and the force of gravity. Gravity takes care of it coming and going and so will efficiency take care of quality.

* * * *

New Assistants to the Chief of Ordnance

In order to enable him to obtain complete information in coördinated form regarding any Ordnance activity, Major General C. C. Williams, Chief of Ordnance, has appointed five special assistants who will act for him in the general supervision of all department activities.

Heretofore, the division chiefs have reported directly to the Chief of Ordnance, each being familiar only with the plans and progress of the work coming under his supervision. For example, the Chief of the Engineering Division could report as to the plans made in his division for any Ordnance material but would not be conversant with the plans or progress of the Production, Inspection or Supply Divisions for this material. The appointment of the assistants will therefore, insure all of this information being centralized in one individual who will act as the representative of the Chief of Ordnance, exercising supervision over all the activities of the particular line of Ordnance material which may be assigned to him.

It will be the function of the assistants to decide all engineering, manufacturing and inspection matters concerning the respective Ordnance material over which they have supervision, and where differences of opinion arise between various divisions, they will make the necessary decisions.

One of the particular duties of these assistants will be the observation of low points in the manufacturing program and securing the adoption of necessary measures for their correction.

Simple Drafting Room Methods

How a Machine Building Plant Systematizes Its Drafting Work

By G. F. Hamilton

The methods shown are built up around a visible index that gives the necessary control to group the orders into classes and to follow the work through the drawing room. The way in which the production orders are handled, the ordering of patterns, preparing specifications, writing parts lists, keeping track of blue prints, and recording changes on the drawings, are all described.

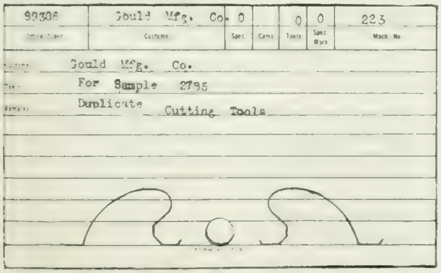
Mr. G. F. Hamilton *has had a number of years' experience in connection with drawing-room systems and methods. He was a draftsman and later chief clerk in the engineering department of the Gould Manufacturing Co. and then chief clerk in the engineering department of the New Britain Machine Co. He is at present engaged on special investigations in the production department of the Seneca Falls Manufacturing Co.*

A SYSTEMATIC handling of drawing-room work is of as much importance as the proper control of production in the factory, particularly in the case of a diversified product the records must be most complete and accurate. The drawing-room system that will be described in this article is in successful use in a large plant building both regular and special machines of widely varying sizes and use. It is hoped that some of the methods presented will be of service in other places.

The machines handled in the drawing room are classified into two main divisions, namely: chucking machines and bar machines.

When an order enters the drawing room it is at once known to which main machine classification it belongs, as all chucking machine orders are written on pink forms and the bar machine orders on blue. As soon as these orders are received they are turned over to the chief clerk of the drawing room who has made out the visible index cards, Figures 1 and 1-A, and the serial number card Figure 2. The visible index cards are filed in a rotary holder, which, when slowly revolved, is arranged to bring all of the cards into sight. One card for each order is filed according to machine number and the other alphabetically by customer's name. See Figures 3 and 4.

The value of the visible index record is to group the orders into their respective classes and to provide means to follow up the drawing-room work on each job. As the different operations are completed, such as writing the specifications, laying out the cams and tools and the like, these are checked on the card. When all of these operations have been checked, it is known that the job is complete so far as the drawing-room work is concerned.



89306	Gould Mfg. Co.	0		0	0	223
[illegible]	Customer	Spec	Cams	Tools	Spec Work	Mach No

Gould Mfg. Co.

For Sample 2785

Duplicate Cutting Tools

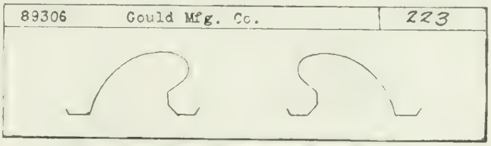
FIG. 1. VISIBLE INDEX CARD FOR DRAWING ROOM

The next step is to make out a serial number card shown in Figure 2. On this is recorded the serial number of the machine, customer's name, machine number, lot number on which machine was built, and the date of shipment. The serial number of the machine and the date of shipment cannot be recorded until the machine has been shipped. These cards are filed consecutively according to serial number. They provide a valuable record in filling repair orders, as a customer's machine is always recognized by its serial number.

At this stage of the progress of the work the production orders are requisitioned and all of the work done in the drawing room is charged to the proper production orders. The order form (pink or blue as the case may be) is then returned to the chief draftsman who, at the proper time, turns it over to the draftsman in charge of that particular class of work. The production order is primarily for the use of the accounting department in allocating the drawing-room cost on the various machine orders. However, it plays an important part on the "work progress board."

When the production orders are received they are placed in the waiting list on the work progress board. See Figure 5. As soon as the production order is given to a draftsman that job becomes active and is moved from the waiting list to the active list. When the job is finished by the draftsman and turned in, the production order is moved to the finished list and remains there until the machine is shipped. As a matter of fact, very little time is required to attend to this board, and it shows at all times where every job is located.

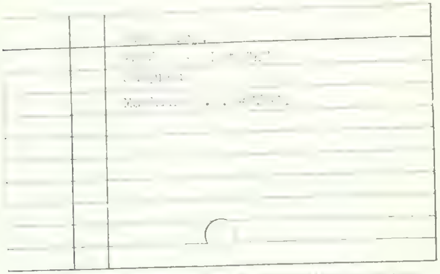
By way of explanation, most of the work is on special customer's requirements, and therefore not many tracings are needed. The drawings are usually made on heavy detail paper and photostated, or on light bond paper and blue printed. All drawing numbers are run in consecutive order. The letters of the alphabet are prefixed to these numbers to designate the various sizes of drawing sheets. Thus T-39587 would be a drawing made on a sheet 9 x 12 inches in size; S-39587 would be on a size of paper 12 x 18 inches.



89306	Gould Mfg. Co.	223

FIG. 1-A. DETAIL OF VISIBLE INDEX CARD

The parts for each machine have a special series of numbers with the machine number prefixed. Thus all part numbers for a No. 124 machine would run like this, 124-1, 124-2, 124-3 and so on. Similarly all part numbers for a No. 172 machine would have a series as 172-1, 172-2, 172-3, and so on.



[illegible]

If it is necessary to make a pattern for any part, the pattern takes the same number as its part. In case a pattern numbered say 172-423 can be used on a No. 226 machine, the pattern number is left the same, but a new part number is taken for the piece. Thus we might have:

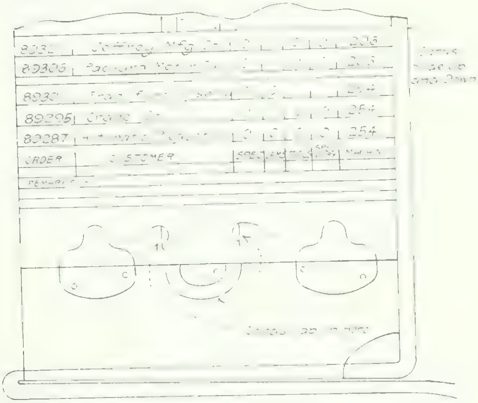


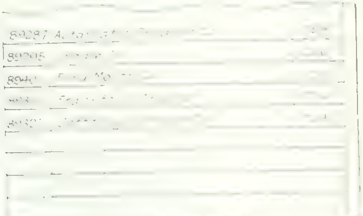
FIG. 3. ROTARY HOLDER FOR INDEX CARDS

Bracket Pattern 172-423, Part 172-423, Drawing T-39857.

Or we might have:

Bracket Pattern 172-423, Part 226-871, Drawing T-39952.

In the first case it is necessary to make a new pattern, in the second an old pattern can be used. Drawing cards, part cards and pattern cards, are numbered ahead by the record clerk and are always available for the draftsman's use as wanted. The draftsman does not fill out any part of these record cards. He merely takes the cards he needs, puts the numbers on his drawing, and clips the cards to the drawing to which they apply. When the job is completed, drawings and part lists, if any, are turned in to the chief clerk, who has the necessary record cards and part lists made out on a typewriter.


89287
89295

[illegible]

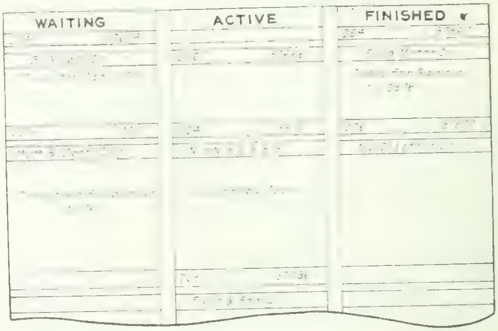
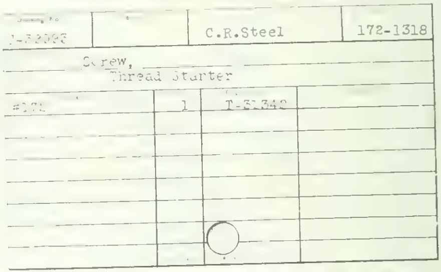

WAITING
ACTIVE
FINISHED

FIG. 5. ORDERS IN [illegible] BOARD

If it is wished to locate the drawing of a part, when the part number is known, the part card, Figure 6, is looked up. On this part card a column marked "first used on" is particularly valuable, as it shows the part list on which the part is used. These part cards are filed consecutively according to number.



C.R.Steel

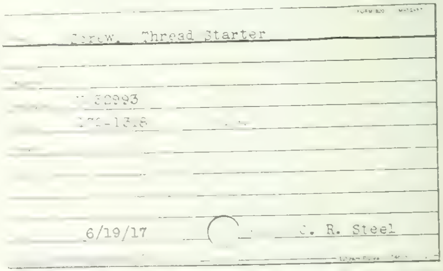
172-1318

Screw,
Thread Starter

1

FIG. 6. CARD SHOWING DRAWING NUMBER OF A PART

For locating a drawing, when the name of the part only is shown, the "alphabetical card," Figure 7, is looked up. These are made out as a cross file for the part cards. They are filed alphabetically according to the name of the part. The pattern card, Figure 8, is used to locate the drawings in the same manner as

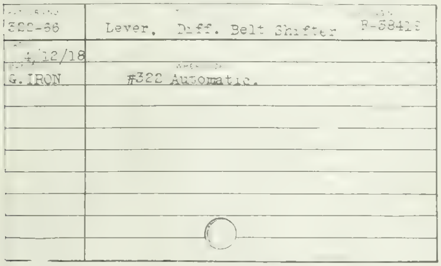


Screw, Thread Starter

6/19/17

C. R. Steel

[illegible] CROSS FILE WITH THE PART CARDS the part card, and is filed consecutively according to pattern number.



322-66

Lever, Diff. Belt Shifter

P-38419

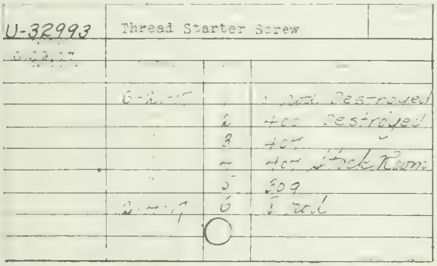
4/12/18

G. IRON

#322 Automatic.

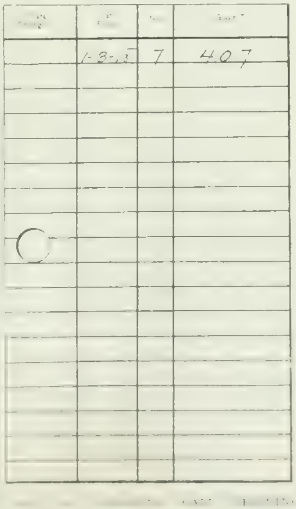
FIG. 8. CARD SHOWING PATTERN NUMBER

The drawing cards, Figures 9 and 10, are made out by the clerks from the drawings to which they apply. They are filed numerically, according to drawing number, and serve as a print record card. If the first print is sent to the production department, the second to department 400, and the third to department 407, the card is marked as shown in Figure 9. The prints are then marked as follows: Production Department, No. 1; Department 400, No. 2; Department 407, No. 3. If a print were sent to No. 407 Stock Room and one to Department No. 309, these would be prints No. 4 and 5, respectively. Now, should a new print be required in the Production Department, the old print No. 1 would be returned and a new print No. 6 issued. Print No. 1 would then be credited on the print record card by being marked "destroyed," and the new print would be charged out as No. 6. So this blue print record shows the number of prints outstanding and the departments to which they have been issued. Should a change in a drawing necessitate recalling all the prints they can be located at once.



U-32993	Thread Starter Screw	
6-2-17		[illegible] Destroyed
	2	400 Destroyed
	3	407
	4	407 Stock Room
	5	309
2-[illegible]	6	Prod

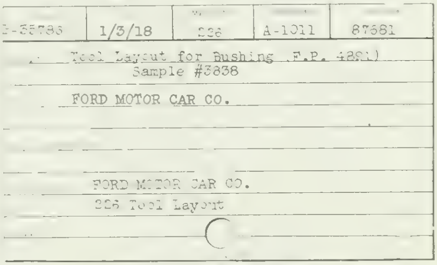
FIG. 9. DRAWING CARD WITH RECORD



	1-3-18	7	407

[illegible]

The specifications covering the machine on order in a broad sense as to machine proper, form of drive, tools and special equipment, are roughly written by the draftsman who is getting out the order. These rough specifications are turned in to the clerical department, where they are typewritten. Standard forms are established so that the detail of preparing these specifications is more of a filling-in process than one of actual writing.



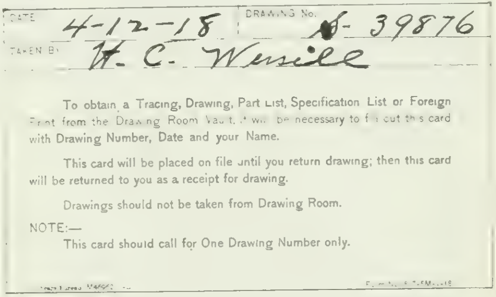
[illegible]-35786	1/3/18	226	A-1011	87681

Tool Layout for Bushing (F.P. 4891)
Sample #3838

FORD MOTOR CAR CO.

FORD MOTOR CAR CO.
226 Tool Layout

FIG. 11. CARD USED FOR BOTH INDEXING METHODS



DATE 4-12-18 DRAWING No. S-39876

TAKEN BY H. C. Weuile

To obtain a Tracing, Drawing, Part List, Specification List or Foreign Print from the Drawing Room Vault, it will be necessary to fill out this card with Drawing Number, Date and your Name.

This card will be placed on file until you return drawing; then this card will be returned to you as a receipt for drawing.

Drawings should not be taken from Drawing Room.

NOTE:—
This card should call for One Drawing Number only.

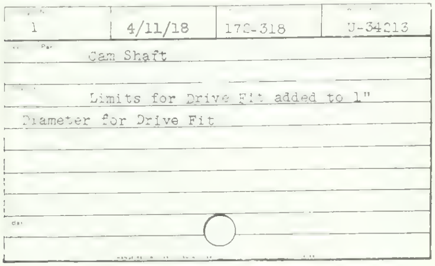
FIG. 12. REQUISITION CARD FOR OBTAINING A DRAWING

The part lists are prepared much in the same manner as the specifications, only that every part of the machine and equipment is listed thereon, even to the bolts, nuts, keys, cotter pins, and such small parts. The parts lists are divided into several groups as head, spindle, countershaft, etc. The names of the parts under these headings are written on the lists in alphabetical order as: Bearing ———, Box ———, Brasses ———, Shaft ———, Yoke ———.

FIG. [illegible] METHOD OF SHOWING CHANGES ON DRAWINGS

All of the specifications, parts lists, layouts and the other important records are cross-indexed. The index card, Figure 11, is used for both methods of indexing. The difference between them is that one card reads "Cross-indexed under Ford Motor Co., File ——— 226 tool layout," while the other reads "Cross-indexed under ——— 226 tool layout. File Ford Motor Co." Thus, one is filed under the customer's name and the other under No. 226 machine-tool layouts. Under the heading Ford Motor Car Co. in the customer's index will be found a record of all machines shipped to that firm. Under No.

226 machine-tool layouts will be found a record of all No. 226 layouts that have been made to date. By the use of this record an old specification part list or tool layout is often located and used on an order for a new machine.



1	4/11/18	172-318	U-34213

Cam Shaft

Limits for Drive Fit added to 1"
Diameter for Drive Fit

FIG. 14. CHANGE RECORD CARD

All prints that are received from outside of the factory are called "foreign prints" and are given a number with the letters F. P. Prefixed as: F. P. 4896. Such prints are indexed under the firm name where they originated and under the name of the part that the print shows. Thus, a print of a piston pin received from the Packard Motor Car Co. would have a card filed under Packard Motor Car Co. and another card filed under the heading piston pin.

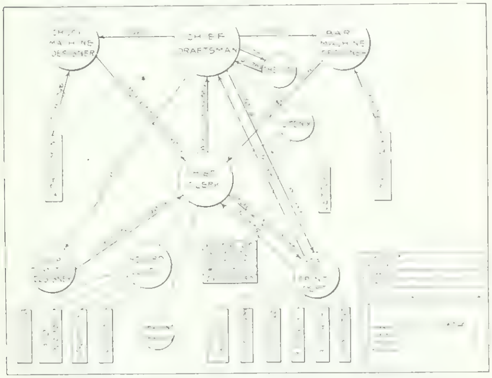


FIG. 15. ROUTING SYSTEM OF DRAFTING DEPARTMENT

The samples that are sent in to show how machines should be tooled, are taken care of in practically the same way as foreign prints, a small tag bearing an identification number is attached to each sample, and the sample is known by that number thereafter. Two record cards are also prepared and filed the same as the cards for foreign prints, each bearing the box number in which the sample is stored.

To obtain a drawing from the storage vault, the form of Figure 12 must be filled out. These requisition cards are filed by the boys in the vault to show who has every drawing that has been issued. When the drawing is turned in to the vault, the card is taken out of this file and destroyed.

When a change is made on a drawing it is marked with a number as in Figure 13, and a change record card is made out, see Figure 14. All of the information pertaining to the change is recorded on this card. In this case limits were added to make the one-inch diameter a drive fit.

The final illustration in this article, Figure 15, is in the nature of a chart that is self-explanatory, as it depicts the manner in which the work is routed through the drafting department.

* * * *

Efficiency—Stop! Look! Listen!

By V. J. Loomis

Superintendent, Dodge Steel Pulley Corporation

EFFICIENCY—Stop! Look! Listen! by Mr. W. H. Smyth, in the September issue of INDUSTRIAL MANAGEMENT challenges an answer. The writer of the article asks some questions, as:

"What do we mean by efficiency?"

"What is the goal of the art of efficiency?"

"To where are we headed in so mad a rush?"

And he makes some statements, one of which is "our efficiency economics divides the wealth—quite otherwise—two-thirds to two per cent. of us and one-third to ninety-eight per cent."

To me efficiency means the best, easiest and most economical means of production. Our grandmothers sat up nights till ten or eleven o'clock darning the stockings for a family of ten or a dozen. Our daughters in an eight-hour day knit enough new stockings for several families. That is efficiency. "Nervousness" hinders efficiency. Efficiency is not a "mad rush." A mad man is not efficient. The morning paper states that in Japan they have reduced the hours of labor for women and children from 14 to 12 hours per day. This is perhaps made possible by their use of power circular saws instead of the old-fashioned hand saw to manufacture lumber, together with other means of efficiency.

Efficiency lays pipe lines for water and oil where a bucket on the head of a carrier was formerly used. It establishes big plants for production where one man can do one thing continuously for eight hours, becoming an expert, and producing a hundred times as much as he formerly could without the big plant, when he was a novice in nearly everything he tried to do and worked 16 hours per day. Efficiency permits the much condemned meat packer to sell all the meat in a steer for less money than he paid for the steer and yet grow rich on by-products. Could the country butcher do it?

To do a deed with maximum intelligence, using the most highly developed instrumentality possible is efficiency. Efficiency saves labor, saves nervous breakdowns, and saves us from "so mad a rush." It is increasing the length of the average life and giving it more to enjoy than kings could command in days gone by, in those good old days of inefficiency. The fireman who fires his boiler efficiently does not have to handle so much coal or work so hard to produce a horse power.

LET BOTH GOOD AND BAD BE EFFICIENT

It would be nice if only the good could be efficient and the "burglars" and bad men were bunglers, but I would rather see the good and bad both efficient than the good and bad both bunglers. The "purpose or goal of efficiency" is production in quantities sufficient to supply every human need and pleasure. With perfect efficiency, possibly every tired, nervous, mad rushing human being could do easily in five hours enough work to permit him to ride up and down the beautiful highways of the country the remaining hours of the day or night to his heart's content. This is not Utopia; it is efficiency carried to perfection. Long live the "efficiency expert" to "boost that modern craze, the art of efficiency."

While the natural laws of supply and demand are left to their healthy growth, the efficient man is going to succeed in his line of endeavor. Society will not yield up her golden treasures to the inefficient and the efficient alike. We all have an equal opportunity.

Inspection and Quality Control

Helps the Great Purpose of Turning Out a High Grade Product Uniformly and Consistently

By F. E. Merriam

This article is a distinct contribution to the literature of inspection of manufactured products. It deals with the practical application of underlying principles, outlines the organization of an inspection department, points out the divisions of the work, treats of the selection and training of inspectors, tells how to uphold standards, and closes with an especially helpful section devoted to the selection and application of inspection gages.

Mr. F. E. Merriam *is a mechanical engineering graduate of the University of Maine, and served as special apprentice and shop engineer of the plant of the Westinghouse Machine Company, East Pittsburgh, Pa. For several years he has been connected in various executive capacities with the American munitions and war materials industry. He is at present with the Greenfield Tap and Die Corporation, Greenfield, Mass.*

SO many and so divergent views are held concerning inspection that it is well to stop a moment and consider what inspection is, how almost involuntarily it is applied in every day life, and from these learn how reasonable it is to apply it intensively in manufacturing. Perhaps to most people inspection pertains only to the examination of a manufactured product to determine its conformity to a specification. True, so far as it goes, but every individual is an inspector because he has a sort of subconscious realization that all the world is human and, therefore, the quality of its work is not always up to the standard he desires.

For instance, in making a purchase at a store we consider it only good sense to examine the article to determine its conformity to our wishes. The purchases made, we examine the change to see if the amount be correct and the coin not counterfeit. The clerk was human and liable to error. Likewise, the employment manager interviewing a prospective employee, observes the latter closely before hiring him, noting his manner and even his personal appearance, as well as his statement of qualifications. Either act is of the same intent and purpose, namely, inspection to determine the quality of something and its fitness for the proposed use. These illustrations hold the kernel of the inspection subject, i.e., that the quality of any article is subject to change regardless of the precautions taken in its manufacture and distribution, because the human element is involved. Here is the real reason for the existence of supervision and inspection. Even our forefathers in the most primitive days were dependent on the principles of inspection for self protection. Mr. G. S. Radford, writing in INDUSTRIAL MANAGEMENT, October, 1917, developed this point in connection with manufacturing.

Included in this human element of which we are speaking is the fact that we have not yet learned to do things perfectly, even when of good intent, and so, when to human fallibility is added occasional indifference of some one in the long line through which raw material must pass before it appears as finished product, the chances of error become great. All this considered, there is reason for wonder that manufacturing processes are as nearly perfect as they are; and added proof of the importance of inspection.

Inspection will be discussed in this article because of its great importance and vital necessity to the successful manufacturer in securing uniform product.

Inspection Is Expensive

The requirements of consumers that goods be of a certain specified quality is the occasion of much expense to every manufacturer on account of the many costly refinements necessarily demanded in his processes, increased supervision and loss from defective goods. The reduction of these expenses forms a problem for which the manufacturer must constantly seek new and better solutions, and, while inspection of the product is of much assistance in improving processes, nevertheless its greatest usefulness is found in the prevention of loss from defective goods. This is a matter of quality control which, intimately related to manufacturing processes, forms a distinct and separate problem for whose solution inspection has proven the most efficient answer.

The success of inspection in decreasing the quantity of defective goods is based upon the fact that to maintain the necessary standard of excellence with minimum loss the quality of the product must be known at all times. Given this knowledge, remedies may be devised and applied, thus preventing the perpetuation of the mistakes. The importance of constant knowledge of quality cannot be overestimated, for it is the key to quality control and constitutes the aim of every good inspection system, as the experiences of munition manufacturers well illustrate.

After devising successful methods of manufacture many still produced defective goods in large quantities, and only through the introduction of thorough inspection systems was it possible to produce in large quantities and at a profit. Many manufacturers were slow to realize that their difficulties could be decreased by other than mechanical means, and while the writer often heard inquiries concerning tooling methods he seldom noted any as to inspection. The importance generally attached to inspection in successful quality control is well illustrated by one manager who thought two or three inspectors sufficient for an output of 4000 to 5000 finished shrapnel per day. For proper quality control the inspection facilities must receive the same careful attention as the mechanical. This is a corollary, for it is obvious that the output is more definitely established and better known when it can be certainly predicted that, out of a certain quantity of material put into the factory, a certain amount of product, within small limits, will be available for sale.

Indirect Advantages of Inspection

More advantages, however, usually follow, for when so much is known about quality the knowledge of other conditions is greater and remedies may be applied.

Further, the benefits derived from inspection are not confined to preventing defects but are far reaching, including all who are involved in manufacture, both workmen and executives. Adequate inspection increases production because the workmen produce more and better goods when they know the quality is controlled because of the confidence it gives them; and the executive ceases to worry about losses in defective goods and devotes more attention to other problems. Likewise, the definite knowledge and control of quality secured by first class inspection, not only creates confidence in the management and workmen but possesses the advantage of enabling the manager to forecast more definitely the results to be accomplished by his organization.

Another important advantage secured by proper control of quality is found in the definite standards that are necessarily established, for there can be no inspection without standards.

Need for Standards

The average shop drawing shows few if any tolerances for the various dimensions, thereby leaving the matter to the shop. In every factory there are standards for the various parts but often these are not in writing nor recorded so as to be easily used. Where a good system of inspection is in force all such information is collected, and in place of several standards one is established for all to work to. To understand the advantage of such positively established records consider a new workman in the shop. With no record of allowable tolerances available how can he know what is expected in the way of dimensional quality, however good a mechanic he may be? It is true the foreman can instruct him, but much time is lost in that way. The average foreman is very busy and can devote but little attention to each individual man. Further, the foreman should not be required to devote his time to anything of this nature which can be made a matter of record that all can understand. Also, the foreman may change and thus quite upset the standards.

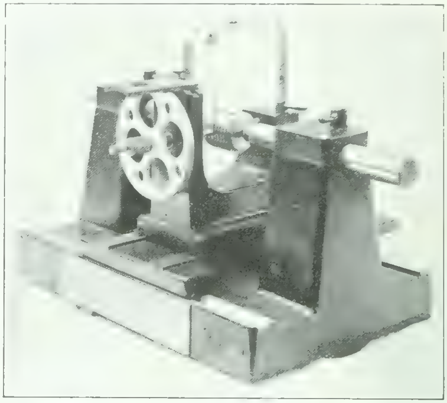
The matter of quality of finish is similar, and the establishment of definite standards by models is of great assistance in improving shop conditions and ease of manufacturing.

The establishment of quality standards will do much to eliminate disputes between the machining and assemblying departments, for each will know in exactly what conditions the product must enter and leave his department. The mere existence of standards is of great influence in improving quality.

Organizing An Inspection System

Having reviewed some of the ways in which inspection benefits the manufacturer, attention must naturally be drawn to the manner of organization for developing an inspection system. However, before proceeding to the details of organization it is important to emphasize the obvious fact that there are as many different qualities of inspection as of anything else, just as there are of goods, for example. Also it is only the highest grade of inspection that will fully secure the advantages enumerated.

There are differences of opinion as to what constitutes inspection, most of them measurable by the extent to which the manufacturer takes the purchaser's viewpoint. It is true that he must balance the purchaser's requirements against his own profits, yet at the same time he must never lose sight of the user's point of view. The user has a tendency to be over exacting and the manufacturer just the other way. This is natural, but the middle ground is the point of maximum advantage. To the manufacturer inclined to be lax in the matter of quality, an occasional inspection and relatively little knowledge of quality will seem to furnish sufficient control; but the manufacturer who is desirous of meeting all reasonable demands will place a higher standard for his output and will not be satisfied with the inspection provided by the other, nor will it economically serve his purpose. Aside from any matter of opinion, however, there exists a test for the quality of inspection based upon its function, and this is, Does inspection furnish reliable and intimate knowledge of the quality of the product at all stages of manufacture? This is the "acid test" for every system of inspection and the response will depend upon the manner of organization and administration.



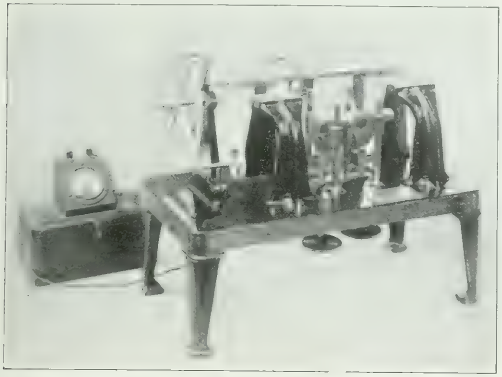
MACHINE FOR THE TWO WIRE MEASUREMENT
OF SCREW GAGES
Courtesy of The Greenfield Tap & Die Corporation

As has been noted, the manner of organization of the inspection department must be along such lines that it may successfully perform its functions of controlling quality. In practical organization we find a number of theories commonly held and practiced, the nature of which is such as to defeat the fundamental purpose of inspection. The more common of these confuses the relation of inspection to production and, by giving to production certain responsibilities properly belonging to inspection, the control of quality is accomplished by neither, as might be expected. In many organizations the inspection is under the direction of the superintendent who is also in charge of production. Upon him devolves the responsibility not only for producing in the largest possible volume but also for detecting defective manufacture and passing upon the final disposition of goods of a questionable quality. Such an arrangement is fatal to proper quality control, for any one holding responsibilities of such a diverse nature cannot well do justice to either. Inevitably production will be favored and quality will suffer.

Producing and Inspecting Are Different Functions

Of course, every manufacturing firm faces two problems—producing and maintaining quality. These are equal in responsibility and importance; the heads of these departments should rank equally in the organization. This is important, for the effective control of quality demands an active head of the inspection department with ability, authority and standing equal in every way to that of the head of production.

Any attempt to combine these functions in one person must necessarily fall short of complete success, for how can the person who makes an article take an unprejudiced view of the quality? To such a party the difficulties of manufacture loom largest and make it difficult to see the product from the user's standpoint. Each added refinement appeals to the producer as calling for so much more difficulty in manufacture and, necessarily, the tendency is to keep to the old ways which do not interrupt, rather than make changes to keep up to the demands of the trade. This view is proper, for it is eminently necessary to consider these things before making any changes; but it must be balanced by considering the other point of view as well. The head of the inspection department whose principal interest in the product is its quality, maintains the balance. This latter point of view is particularly valuable in determining the settlement on defective goods.



MACHINE FOR MEASURING THE ELEMENTS OF THREAD GAGES
Courtesy of The Greenfield Tap & Die Corporation

Need of Specialized Inspection Knowledge and Skill

Such a division of responsibility for handling the important duties of production and inspection also possesses the advantage of making them specialties, and this tends toward more efficient management. The principle of having machine operators specialized is well recognized and established, and holds equally good in the field of inspection and quality control. The need of specialization is as noticeable in this department as in the case of the detail inspector or workman.

In any factory there constantly arise small incidents, insignificant in themselves, yet sometimes heralding the approach of serious trouble. The trained and specialized department head is keenly alive to the importance of such symptoms and does not await for something serious to happen but takes preventive action at once. The ability to detect the smaller symptoms can scarcely be so highly developed where other matters than quality control must have equal attention.

Not long ago while visiting a cantonment the writer observed a company of soldiers marching and apparently all were in line and in step. Not so, however, for the sergeant, who had been looking straight ahead, suddenly gave orders to the rear ranks to fall in step and keep in line. How he knew, without looking, that there was anything wrong we can readily guess, but the uninitiated and unskilled would not have detected the symptoms until they became much more pronounced.

The symptoms of approaching trouble in manufacturing are sometimes of quite a varying nature and require the attention of the specialized department head. Mr. Douglas Hamilton has recently said that the manufacturers of shells, early in the war, suffered considerable losses on account of the double requirement of dimensional and weight specifications. The unusual nature of these requirements, together with the many variables involved, constitute a symptom obvious enough when pointed out but not always noticed, it seems. The productive department, with its mind filled with the problems of how to manufacture, has but little time for thought of such matters at the commencement of a project of this kind, but an inspection department whose sole duty it is to foresee and detect trouble could have more certainly detected and properly appraised such a symptom. It may be argued that such matters as the relation of weight to dimensions is more a matter of design than inspection; while this is doubtless true, nevertheless it did not prevent many manufacturers from suffering much loss. A separately organized inspection department is far more likely to detect such things than a combination department.

The desirability of entirely separating inspection and production has been proved by some of the large munition manufacturers who have tried both plans, and it is only the separate organization that has successfully met requirements of maintaining quality. There are also a considerable number of concerns that have adopted this plan for many other lines of work.

The point has already been made that inspection must not only detect manufacturing errors before the product is finally delivered to the consumer, but it should also endeavor to detect the errors as they arise and hold them within the smallest practicable limits. To accomplish these ends the activities of an inspection department are usually divided into two distinct parts: process and final inspection. The nature of each is obvious.

Process Inspection

The part played by process inspection in the control of quality is, in a large degree, preventive, but it also has an important bearing upon the character and extent of final inspection. Process inspection is preventive because it detects manufacturing errors in time to prevent their becoming widespread, and the extent of final inspection is determined in a considerable degree by the effectiveness of the process inspection. In the practical development of process inspection it is found, in reality, to comprise rather more than the examination made by the inspectors, for the workmen do a certain amount of inspection particularly in connection with setting up the tools, etc. This inspection is necessarily quite variable and limited in its scope, and cannot be depended upon to maintain quality to the desired degree. In the same way the foreman usually examines the work occasionally to satisfy himself of the quality; but this, too, is necessarily of infrequent occurrence and will not wholly control the quality. With an effective process inspection in force, under the supervision of the inspection department, these other checks need be applied only occasionally.

The process inspection of the inspection department must be of quite a different nature than that just described, for upon it falls the responsibility for detecting defective manufacture as nearly as possible at the time when it first occurs. The point must be constantly borne in mind that it is not sufficient to find occasional mistakes, but the process inspection must be able to detect, so far as possible, *all* the mistakes that are made. A very large force of inspectors can accom-

A SEPARATE INSPECTION ROOM FOR THE PRODUCT OF A LARGE FACTORY
Courtesy of The Greenfield Tap & Die Corporation

plish this but that would make the expense of inspection out of proportion to the benefits derived in most cases, so the problem of the department is to determine the most economical amount of inspection. Many variables enter here, such as the value of the product itself, for the greater its value the more necessary does it become to save each piece. In the case of an inexpensive product, however, such as small screws, necessarily but little cost can profitably be incurred per piece.

Influence of Subsequent Operations

Another factor of importance is the subsequent work to be done on the piece and where it is to be done. Where the succeeding processes are expensive, or perhaps performed at some distant point, it is important to prevent any defective pieces from proceeding to the next operations. On this account the inspection expense may well be greater than if the work is done in the same factory. The matter of deliveries is sometimes important in this connection and will occasionally influence the extent of the inspection. Obviously, deliveries are easier to make when the proportion of finally rejected pieces is smallest. In short, effective process inspection requires frequent and systematic examination of the product during the various operations. Experience and analysis teach just where defects are most likely to occur and how often inspection must be made to maintain the most successful relation between production and loss. The process must be studied in this light and every effort made to forecast the situation. In the manufacture of almost any article it will be found, if an analysis be made, that some operations or parts of operations more frequently go wrong than others. This may upset the relations necessary for succeeding operations or may not appear until assembly. A case in point is the diaphragm seat in shrapnel. A considerable variation in the height of this seat will make no difference in the finishing of the other parts of the body but will interfere with proper assembly. This part of the body has often caused machining trouble and so has merited more attention than some other portions of these shells. The process inspection would need to be made more frequently on such a part.

Certain kinds of tools have only a brief life and the operations where such tools are used must receive more attention. Again, certain portions of a piece are used as points of reference for other operations and these must be given special attention on account of their importance in keeping the succeeding operation correct. The operators, too, must come in for consideration because they vary greatly in the accuracy of their work and inspection must watch them accordingly. The final check upon the effectiveness of the process inspection is determined by the percentage of parts defective at final inspection. A study of the reasons for final rejections will be the most effective check upon the success of the previous inspection and will indicate just how it should be adjusted to meet the requirements most successfully. Furthermore, records should be made to indicate the effect of any change made and should form the basis of decision as to future action in cases of this kind.

To illustrate what is sometimes the extent of process inspection the case of shell forgings may be cited where one manufacturer found that by making a process inspection of about one forging in 12 to 15 the final rejections by the purchaser were not one-fifth of what they had been previous to the process inspection.

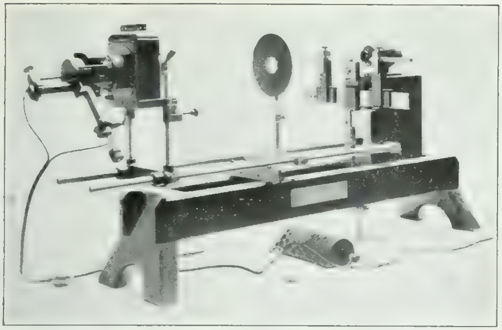
Final Inspection

Final inspection, of course, refers to the examination of the article, or product, upon completion and the arrangements necessary for this work will depend mainly upon the nature of the product. For example, if the product is a one piece article the final inspection means a checking of all the dimensions and their relations to each other. If, on the other hand, the product is an assembled affair, then the final inspection will be a rechecking of the process inspection on the component parts, and an inspection of the assembled whole. The final inspection of the component parts may seem unnecessary after the thorough process inspection advocated by the writer, but it is again the proposition of the value of knowing the quality, as the final inspection makes possible the checking of the relations of the various dimensions to each other. For example, one of the tests in the final inspection of some kinds of shells is to place over them a plate cut out to the exact contour. This checks the relation of the various parts of the shell to each other and cannot be made until it is completed. In the case of some parts there are holes, for instance, that have certain definite relations to each other. The checking of these relations can best be made upon completion of the article. In the case of an assembled product, such as a machine, final inspection must include running and alignment tests, finish, general appearance, etc.

In final inspection, too, there are certain checks made of quality in addition to those by the regular inspectors. These are frequently of considerable importance. In the case of single parts there are but few of these supplementary tests or checks, for none of the workmen are directly interested in such matters and any checking made by the foremen will usually be of the nature of a process inspection rather then a final inspection.

Inspection By Assembly

In the case of an assembled product the assembly process forms a most important check to and upon inspection. The assemblying is the final, absolute test of the quality of the component parts, so far as dimensions are



PROJECTING MACHINE FOR THE INSPECTION AND STUDY OF SCREW GAGES
Courtesy of The Greenfield Tap & Die Corporation

concerned, and demonstrates in an inexorable manner the quality of the workmanship and the effectiveness of the inspection. Assembly is, in fact, at once manufacturing and inspection. In this case the primary purpose of dimensional inspection is to assure ease of assemblying, and the actual assembly is the final test of the extent to which this is accomplished. If the parts go together with slight difficulty, or no difficulty at all, then inspection has accomplished its purpose so far as this phase of the work is concerned. On the other hand, failure to assemble shows at once the weakness of the inspection and just where to apply the remedy.

It may perhaps be asked why, if assemblying tells so much about the dimensional quality of the work and is even used to check the quality of the inspection, have inspection at all; why not save the expense The answer is found in the time element of the two processes. Assemblying makes its check after the component parts are made, right or wrong, and too late to apply a remedy. It is like the proverbial "locking the door after the horse is stolen." It contains no preventive element, except for the future, since the facts it brings to light refer to a condition passed and gone, which cannot be altered. Inspection, however, detects the mistakes dur-the process of making and checks them at once. This means that if the quality is determined by assemblying alone, much defective material is likely to be made before the error is detected and much loss thereby result, as well as an unnecessarily high assemblying expense. It is evident then, that while assemblying is a final and authoritative check upon the dimensional quality of the product, from the point of view of quality control it must be considered as secondary, or supplementary and not of primary importance.

The problem of determining the correct amount of final inspection must be worked out upon the same basis and, considering the same items as in the case of process inspection but some further items enter here. Many manufacturers make running tests upon every piece of apparatus though this involves much expense. The reputation of the product is of very great importance and is well worth a considerable expense.

Separate Inspection Rooms

The details of carrying out the final inspection of parts necessarily must suit conditions but, where practicable, they should be taken to an inspection room separated from the productive departments. Here may readily be provided suitable gages, tables and other facilities essential to rapid and reliable inspection. The importance of providing an inspection room separate from the productive departments can scarcely be overestimated, for only in this way is it possible to secure the isolation and convenience necessary for the largest and most accurate output of the inspectors.

The Use of Gages

In many instances the inspection is, to a great extent, a matter of measurement of dimensions, necessitating the use of gages or other types of measuring instruments. In fact, there is but little inspection in most mechanical plants which does not require some gaging, not only for the purpose of controlling dimensions, as for fits, but also because of their close relation to other matters of quality, such as strength.

Because of the importance of gaging it is necessary to bear in mind a few principles if the selection of the types of gages and their use are to be wisely accomplished. The designer must bear in mind that gaging is more than an abstract checking of dimensions, it is rather the determination of necessary relations between various portions of a given part. Therefore, he must consider how the piece is to be used, its function and relation to other parts. This will also involve a knowledge of the manner of making the part, for both gaging and manufacturing must approach the problem from the same angle. In the case of almost every part there are certain dimensions governed by relations to certain other parts with which it must coördinate. Again, there are other dimensions governed mainly by considerations of strength and appearance. The designer must distinguish between these and so design the gages as to determine the dimensions from the viewpoint of their purpose. The measurement of dimensions whose principal object is strength is usually simple, but this should not cause the designer to become forgetful of their importance.

If the chief function of certain dimensions is strength the system of gaging should, so far as possible, gage in the direction in which strength is required. That is, the gage should be applied as directly as possible in the direction in which the stress will be applied, thus making the measurement directly where the size is needed. Often this is the easiest and most natural way to design the gages, but sometimes it is not, and in such cases considerable study is sometimes required to find the direct way to attain this object.

A shaft will serve to illustrate both these cases. Shafts are subject to both torsional and bending stresses, and while gaging cannot be done in the direction of the torsional stress yet the diameter which is easily measured is the principal consideration in resistance to torsion. It is also a principal consideration in resistance to bending.

Dimensions which pertain to appearance can frequently be taken directly, but often appearance is secured by less direct means. Appearance is frequently secured by curves, usually generated by arcs of circles joined in various ways, and sometimes by irregular curves of less simple construction. Such outlines are usually difficult to measure if an attempt is made to follow the manner of their generation. But by the use of template gages they may be measured directly in the manner in which they appeal to the sense of symmetry.

Gaging Dimensions Controlling Functions

Dimensions whose functions relate to the operation of the machine—as the center distances of shafts, dimensions essential to the fitting together of parts—as gears and pulleys, have as their aim successful assembly and proper working of the apparatus. Parts of this nature should be gaged and checked on principles similar to the operating conditions. For smaller sized gears a common method is to have pins set in a plate at the same center distances as the shafts on which the gears are to be used. By placing the gears over the pins their dimensional quality, as far as running is concerned, is readily determined. In the case of shafts and bores, plug and ring gages are a close approach to actual use, but for closer work the snap and flat gage are essential for determining if the pieces are actually round.

Sometimes there are conditions which prevent direct measurements. One of these most frequently found is a size so great as to make direct measurement difficult if not impossible. In the case of large turned diameters a point can be fixed on the machine in which the part is made and a small gage used between the periphery and the established point. This is better than a gage reaching entirely across the piece for it would be so long and cumbersome as to be inaccurate. For large bores a point can be established, as in the center of a boring mill platen, and measurement is then easily made to the bore of the piece from the plug.

Gaging Parts With Reference to Following Operations

The gaging of parts on which further work is to be done requires consideration of the operations to follow and, therefore, the gages should, so far as possible, be designed on principles similar to these operations. Of this nature are forgings for shells. The exterior is later turned concentric with the bore and gaging must make certain that it will finish both inside and out. These forgings can be measured either by wall thickness or by a revolving on a mandrel gage carrying the forging true with the bore. The latter method is more desirable because it corresponds with the principle upon which these forgings are machined. Measuring the wall thickness together with the gage for the outside and inside diameters is on an entirely different principle than the finishing process, and cannot allow for the walls not being straight, either inside or out, and will frequently prove misleading. It is not always possible to design gages in full accord with these principles. In such instances special effort must be made to provide more than one check, thus making certain that the pieces measured will finish in the succeeding operations.

The problem of simple or multiple gages to cover several dimensions always arises and the answer must be found, in most cases, in the quantity of duplicate parts to be measured. As in machining, so in gaging, where there are large quantities the most economical method is usually the simpler. The class of inspectors available also deserves consideration, for unskilled inspectors can handle simple gages more effectively than multiple. Where the quantity of parts to be checked is small the gages must be of as inexpensive a design as possible. If the wear is likely to be considerable, provision must be made for easy and inexpensive renewals.

Gage Care and Storage

The inspection department must provide a suitable place for storing gages not in use, for their protection against damage by fire and moisture, and to guard against loss. Such tools are very valuable and a fireproof vault should be provided for their safe keeping, or, at least, a safe if their number is insuffiscent to justify the expense of a vault.

The inspection department must keep a record of each gage and what it is for, so it may readily be identified either when the piece to be measured is known or the gage number. The gage record should contain a complete account of the tool, or else refer to a drawing.

INSPECTION BY THE MACHINE OPERATOR
Courtesy of The Greenfield Tap & Die Corporation

One of the most important matters is the systematic checking or inspection of gages. It is not enough that a gage be well designed, precisely made and thoroughly adapted to the intended use, it is equally essential that the precision be continuously maintained and any departure therefrom known. There is no fundamental difference between the function of gage inspection and product inspection, for the purpose of each is the maintenance of quality; in the one case of the product and in the other of the standards. Whenever the quantity of gages in use is sufficient to warrant, there may well be several inspectors whose sole duty is the checking of working and inspection gages, as well as new gages before they are put in service. These inspectors must, of course, be provided with instruments for precision measurements such as standard gages, micrometers, etc., depending upon the nature of the product. If the product is of a very refined character involving close screw thread work, for example, refined instruments for measuring the elements are likely to be necessary. Munition work furnishes an illustration of great refinements in gage checking.

Many of the qualities of a product cannot be measured by gages or similar instruments but must be determined by visual inspection and so, not being susceptible to as positive a determination as dimensions, are more difficult of maintenance. These are mainly matters of appearance and are particularly important in those products where a high degree of finish is necessary, and in cases where the quality of the material is to be determined visually as by steel fractures.

Visual inspection is essentially a work requiring good judgment and memory. To become skillful experience, study and training are essentials. Models illustrating the requirements are, however, the most important factor in controlling these qualities, for it is a matter of securing their duplication in the product. Such standards will deteriorate with time and use and regular systematic inspection should be made of the standards, which may well be a duty of the gage inspectors.

Inspectors for this kind of work are not, as a rule, so easily trained as those using gages; but their breaking in can be much facilitated by confining a new inspector to as limited a range of work as possible. A new inspector, at first, should not be required to examine more than a few different kinds of parts, in order that the work may be thoroughly and efficiently performed. The standards must be near at hand where he can easily see them and make frequent comparison with the product. The same methods are also applicable to training work in manufacturing departments.

The Final Test of Inspection

The justification of any inspection system must in the final analysis be found in the financial improvement of the business. This may appear in different ways such as a better price for the improved product, maintenance of the reputation for high quality, an increased demand for the product, fewer damage claims, etc., all of which have an important influence on dividends. Such matters are improved not so much by occasional high quality as by a consistent quality of the proper grade. Throughout this paper the writer has sought to make clear that quality must be controlled at all times, and that a consistent knowledge of quality is fundamental to this purpose.

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Salvage Department of the Westinghouse Lamp Company

By A. W. Ross

DURING the early part of the year 1916, the Department of the Interior issued a letter of warning to the industrial plants of this country regarding the scarcity of paper and paper-making materials and pointed out the necessity of saving waste paper of every description in order to help relieve the situation.

STORAGE AND BALING ROOM FOR SALVAGED MATERIAL—WESTINGHOUSE LAMP COMPANY

Realizing the importance of this warning, a department was organized in the Westinghouse Lamp Company for the purpose of salvaging waste paper, and commenced operating May 1, 1916.

Waste paper of all descriptions was gathered up by the janitors in the various factory departments and delivered to the salvage department, where it was separated and baled.

It required a little time to educate the workmen in the salvage department as to the various kinds of paper, but this was soon accomplished. The types so far separated are bonds, tissue, krafts, corrrugated board and mixed papers, the latter composed principally of paper from the waste baskets of the office departments.

The salvage values of the various kinds of paper made the separation absolutely necessary. From the organizing of the department on May 1, 1916, to December 31, 1916, 109,452 pounds of paper were baled and sold. During the year 1917, 218,599 pounds were also disposed of, the majority of which went to the paper-making companies. It is needless to say that a fair profit was realized on the investment.

The results obtained from the salvaging of paper have led to greater activities along the same lines. The present salvage department is receiving from all over the works scrap material of every conceivable kind. Old and inactive machinery, steel and wooden partitions, pipe, old belting, copper wire, oil barrels and other containers, in fact, everything with a scrap value.

Inactive machinery when received in the salvage department is taken apart. The iron, steel and brass are separated, all gears, studs and machine bolts being placed in bins and requisitioned by the equipment division to be used over again.

The sale of the materials so salvaged is handled through the purchasing department and the junkman's profits have been considerably reduced through these activities, to the benefit of the company.

The practice of collecting and utilizing so-called "waste" material in large manufacturing establishments is an encouraging feature of modern industrial practice, as well as an evidence of growth of the spirit and habit of economy that it is hoped will spread throughout our national life.

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The need for women in the Army Ordnance Department to release men for overseas service has increased to such an extent that the Civilian Personnel Department is issuing a call for women accountants, statisticians, bookkeepers, cataloguers, engineers of tests, draftsmen and messengers, all positions held until recently by men. Women are already at work as accountants and statisticians, analyzing the costs of materials and labor.

Relation of Statistics and Accounts in Industrial Management

By Milton B. Ignatius

We are much more familiar with cost accounts than with industrial statistics. In fact, only the larger and more progressive manufacturing firms have statistical departments. This article is therefore particularly instructive, for it shows the need of such statistics, it tells what matters should have statistical study, and gives numerous practical points in regard to organizing this work and selecting the statistician.

Mr. Milton B. Ignatius *specializes as an industrial and financial analyst, combining the qualifications of accountant, statistician, lawyer and economist. He is a member of the New York Bar, and the author of a book on corporation accounting and financing. He is at present assistant to the General Valuation Counsel of the New York Central Lines, engaged in a valuation of over 12,000 miles of railroad with its appurtenant properties involving an aggregate capitalization of about one and one-half billions of dollars. From 1908 to 1914* Mr. Ignatius *was accountant and statistician for the New York Public Service Commission for the Second District. In 1914 he was appointed principal statistician for the commission appointed to conduct the traffic and rate studies in the New York Telephone rate case. Later he undertook similar studies for the Public Service Commission, First District, in the Brooklyn electric light and power case. In this work he has won a reputation for keenness in analysis, soundness in drawing conclusions and skill in presenting his results.*

A BUSINESS statistician is by some thought to be as much of a luxury as the carved figures that decorated the bowsprits of sailing vessels of old, or perhaps as the tin traffic policeman or other freakish figure that dances upon the radiator top of an automobile.

We all understand accounts, or think that we do, and admit of their necessity. But what of statistics? Accounts are generally supposed to deal with absolute facts and to be determinative of such weighty matters as assets, liabilities, solvency, profits and dividends. In many a bookkeeper there still exists the feeling of reverence, as it were, for a *book of accounts* which only the initiated and favored might open, and the very permission to handle it is tantamount to signal recognition. But statistics? They rest under a cloud of suspicion as consisting of estimates, averages and approximations. This has been due in largest measure to the unscientific use of statistical statements and the loose estimates and careless guess-work so often "camouflaged" by the designation of "statistics."

What are accounts but financial statistics? The science of statistics is essentially that of counting large numbers, classifying them in an orderly manner, and resolving them finally to a few significant figures. The work of merely counting large numbers of things is a more difficult one than is generally supposed, and where not only enumeration but classification and analysis are required, special methods must be used by skilled workers—skilled to handle statistics as the accountant is skilled to handle figures of revenues, expenses, etc. And is not accounting merely a method of collecting financial figures, classifying them in an orderly fashion, and analyzing them so as to make them reducible to a single final figure—profit or loss?

So far as purpose and aim are concerned, therefore, accounts and statistics have much in common. Accounts can deal with but one unit—the pecuniary unit, which is a figure of dollars and cents; statistics may deal with units of many different kinds.

Accounts and Statistics

A corporation engaged, say, in the leather business, keeps current records of purchases, sales, and costs of processes. These constitute its accounts. But suppose the government in order to keep currently informed of the leather situation in the country assembles and combines all the records of purchases, sales and costs of process of all the companies dealing in leather. We will then say that the government is keeping statistics of the leather business. The facts dealt with in both cases, however, are precisely the same.

Statistics of business, then, are not as unfamiliar as they may at first glance be supposed to be. It will be desirable, however, in spite of the kinship between accounts and statistics of a business to consider them as denoting two classes of facts, the first, all those having to do with the financial status of the proprietors of the business, and their profit or loss from its operation; the second, all those facts of work performed within, or changes of demand or supply without, and every fact reducible to statement in figures (whether of financial unit or not) which serve to express the quantities of labor and material utilized, gradations of kinds and quality, efficiency of operation, the condition of market and its relation to that particular enterprise.

There are two classes of business statistics to be considered—external and internal.

External Business Statistics

External statistics are those that deal with the markets for the products purchased or sold, e.g., measurements of demand and supply, of kinds and quality of competing articles. Important classes of fact in this group are those dealing with financial and trade conditions in general. The importance to every business enterprise of having a regularly constituted department capable of keeping the management advised of these facts is very important indeed, but it is not our purpose to go into that in this article. There is one aspect of it which we must note, however.

The welfare, prosperity and progress of industry have become the nation's business. True, the necessities of war have constituted the chief cause for this conception, but the government having once established such intimate relationships with industry cannot break off, and with the return of peace its responsibility to foster and encourage industry will increase—not lessen. In our international relations the government must stand in the position of agent, as it were, for American goods and commerce and it will therefore need to be in possession of the very facts which have been described above as "external statistics." The requirements of the Government will then impose upon every business of magnitude the necessity of recording the statistics relating to its own operations. Uniform systems of accounts to be established by the Federal Trade Commission, possibly by new state commissions, reports to be rendered to regulating bodies—all these will be influences bringing about the amplification of statistical records of business. That was precisely what happened in the case of railroads and public utilities that have been brought under regulation.

Internal Business Statistics

Internal statistics are the recorded physical facts of operation. A knowledge of these has become essential to the proper conduct of every large enterprise. Ramifications of the larger modern enterprises have become so great; the possible sources of waste in effort and material so numerous and withal so hidden, the points of letting down in morale or individual initiative so difficult of identification, that properly co-ordinated records of all physical facts dealing with conditions of material, of products, or labor are requisite. Reliable statistics now constitute perhaps the only practicable means by which a large corporation can come to know itself, and they furnish essentially the safest basis for the formulation of administrative policies.

In spite of many refinements, the primary purposes of accounting still relate to the treasury—the earmarking of sources and destination in order that funds and claims may be properly identified. collected, and made to discharge the liabilities of the business. Its chief aim is still that of resolving all transactions into net income or profit and loss. Regret it as we may, accounting has not developed into a positive science; to say that "it so appears upon the books," in relation to figures of loss or gain, is not the same as saying that such is the absolute and uncontrovertible fact. The figures reflect almost as much the method of account-keeping as the results of commercial, financial and trading transactions. Statistical summaries of the operating and physical facts will throw much light upon these figures. Moreover, the utility of accounts is limited to the result of operations which are past; but statistical indices of the efficiency with which those operations were conducted will serve to project into the future the significance of the accounts.

Although accounts are financial statistics, they utilize one of the most unsatisfactory units—the dollar! The dollar is the statement of a relationship—of purchasing power of labor or of commodities, of "power in exchange." It is therefore variable, uncertain, and the familiarity of the symbol too often distracts from consideration of the substance—of the thing for which it stands. Financial statistics based on accounts, therefore, should always carry supporting data to facilitate a better understanding.

Limitations of Cost Accounting

Cost accounting is an attempt to get more out of the financial records than a mere statement of profit and loss. The attempt utilizes many classes of physical statistics; in fact, cost accounting is essentially statistics rather than accounting. It is unfortunate, however, that because of its close identification with accounting the impression has been created that accounting methods and processes control, so that sound statistical methods are not usually taught and consequently are seldom used.

Cost accounting records, however, do not make available for regular use all of the internal statistics which should be utilized. The chief limitation is that the final use of the statistics assembled is that of apportioning some item or items of expense. It is not recognized that the facts can have any utility of their own apart from the accounts, and consequently they are neither assembled nor presented in form permitting of their independent use. Very often the knowledge that these facts will not be scrutinized apart from the context of accounting figures leads to carelessness and inaccuracy in the assembling of the subsidiary data. Moreover, in the cost accounting organization the work of assembly and summation is not always well organized nor ably managed, for many an accountant in charge of such work lacks all knowledge of statistical methods and processes, hence he either adopts estimates or obsolete figures for use in the necessary apportionments, or else delays the current analyses, so that when at last they reach the executive offices much of the data will have lost immediate interest.

Even in the best methods of cost accounting the limitation to figures of dollars and cents is controlling, and there remain many factors of operating costs which cannot be measured in these terms; a knowledge of these, however, is just as essential to correct direction of the operations as any item expressed in figures prefixed by the dollar sign.

Accounts will indicate the cost, but cannot indicate the causes which explain that cost. Where a fluctuation in the cost becomes apparent, inquiry is at once directed to the causes therefor. The general explanation can often be given verbally or by memoranda, but where no data have been assembled there is no possibility of checking up the accuracy of the explanation, nor to ascertain if the causes set forth are accountable for the entire amount of the fluctuation or in part only, leaving some causes not set forth which are accountable for the remainder. Then, again, the same general causes will produce varying results at various times, and it is well worth while to have a barometer for each operating cause. These barometers cannot usually be furnished by accounting methods and further assistance must then be obtained from statistical indices.

Statistics Necessary to Explain Cost Fluctuations

The two essential inquiries in passing upon the success of any enterprise are based upon comparisons, the one of the situation of that enterprise at different stages of progress, and the other of its relation to the status of the industry generally. The first question then is, Has the business progressed in its methods of efficient and economical production and favorable distribution? The second, Is it holding its own with competitors? Both of these call for measurements which can only be made statistically. How shall the achievement of the present be compared with the past, except by the use of common denominators? Money is not a common denominator, for the value of money itself fluctuates. Within the last three or four years the change in the value of money has been so great that comparisons based upon the financial results of each annual period are unsatisfactory. Statistics are therefore necessary to formulate these common denominators.

The explanation of an increased cost may be increased wages. But where did that cause cease to be operative, giving way to other factors? Did the increase in wages improve the *esprit de corps?* That would have nullified in part, by speeding up, the effect of the total increase. Or had the increase been so long delayed that the indifference of employees usually apparent at times of great discontent has become a habit with them, so that if increased wages must be paid it is wiser to adopt a program of gradually reforming the personnel? Suppose the increase has affected one department only, has there resulted dissatisfaction in another department, causing a letting down of effort, possibly hampering the very department in which the increases were granted?

Irritation of Verbal Explanations

In passing, it is hard to omit reference to the irritation which results from dependence on verbal explanations or statements based on the personal knowledge of some one, wholly unsupported by evidence. Just when the manager, or any one else, for that matter, has completed his examination of the financial and accounting statements, and thinks that he has reached certain conclusions, he is faced with the comment that, of course, this does not necessarily follow, or that statement is not necessarily true, or this other deduction while apparently justified by the accounts is not borne out by experience, and so on. The writer has known of many managers who have not been able to become trained in the analysis of their own operating reports because of the discouragement they have received from subordinates who have proved to them over and over again the necessity of amplifying the official reports by verbal or informal explanations. Accordingly, methods have grown up perpetuating inefficiency and substituting plausibility of excuse for accuracy of fact. Moreover, where that situation obtains it will usually be found also that the attitude of the management toward its accounting organization becomes one of indifference, viewing it as an evil to be tolerated and kept down to the minimum of expense. Statistical records and reports help to eliminate the guess work, and they will substitute facts for impressions or recollections which are so frequently subject to partial or faulty and consequently misleading statement.

Practical Necessity of Statistical Control

While the method of suplementing the utility of accounting records by personal investigation and inquiry of the management—operation by rule of thumb, as it were—was in many cases fairly satisfactory under conditions of intimacy between owners, managers and operators, that situation is fast changing through the increase of publicity requirements for governmental taxing or regulating purposes, for information of stockholders, for official price-fixing, and for use of referees, arbitrators and commissions, in disputes as to wages, working conditions, etc. In all these instances operating and financial data pass to the scrutiny of men who have no intimate knowledge of each separate business and who must derive all of their knowledge from the reports furnished them or from data which can be furnished immediately upon request, taken from the current records, rather than specially prepared for the purposes of that inquiry. Information compiled for a special purpose carries, to many minds, perhaps also the suggestion that, having been specially prepared, it is biased.

The writer has himself prepared accounting classifications which were officially promulgated by regulating commissions for the use of corporations within their jurisdiction, and he has also prepared forms of report to be used in the rendition of operating and financial reports. He knows very well, therefore, the danger of misunderstanding to which all corporations are subject if they are not equipped with definite and complete statistics. The ability to produce, on short notice, affirmative proof of costs, operating factors, the results of various operating policies, or the condition of the trade, is an asset of the greatest value, especially when public relationships are involved—and public relationships are entering into all classes of corporations. Speaking in Chicago recently, Secretary Lane is reported to have said that all industries are becoming public utilities, meaning that their operations are charged with a public interest by reason of which the public may demand the same publicity of their operations, costs and profits, as it now requires of railroads and other public service corporations. What the public may require, the proprietors should have already required for their own purposes, but have seldom done so.

Great Care Required in Planning Records

There is not space to suggest the kinds of statistics to be kept, neither would it be practicable to outline a set of statistical records without having in mind one particular enterprise. Let it not be forgotten that no greater mistake can be made than that of adopting statistical forms and copying an organization used elsewhere; each business must work out the forms and methods suitable to its own conditions. It is the easiest possible thing to fall into the habit of gathering useless statistics. Proper statistics should show in intelligible form just what is taking place, what tendencies are becoming fixed and what practices are taking root; they must be designed to reveal irregularities and to provide all the information necessary for the formulation of constructive policies.

Incomplete statistics or those not capable of definite use are absolutely worthless. In many plants great sums of money are wasted because of unnecessary records. This is especially true where the administration of the accounting organization has seen frequent changes; each incoming officer has introduced some new record without at the same time abandoning all the records theretofore in use for substantially the same purpose. In some cases the abandoning of the old records would change the organization to an extent which the new incumbent has hesitated to become responsible for; in other cases where the utility of certain records is doubtful, there is reluctance to cancel them for fear that some day those particular data may be called for. A thorough and drastic house-cleaning in these respects will often produce surprisingly beneficial results.

Matters for Statistical Study

In general, the matters to be subjected to statistical investigation will follow the broad lines of business activity. First, materials and supplies, covering purchasing and stores records; second, labor on materials prior to or during use in process and in distribution. Third, products sold. From these will be developed comparative costs, but not always expressed in stated money amounts.

Take, for instance, the first group. The purchase price, together with costs of freight and of handling, is usually charged out as the cost and few, if any, other statistics are kept; and yet, this is one of the most important branches of work to be watched. Statistics of total quantities purchased, the number of purchases, the kinds and grades, the quantities in each purchase, time required for delivery, complaints for defective material—all these would be of inestimable worth. From such facts, properly summarized and analyzed, it might appear, for instance, that the method of requisitioning supplies is faulty; perhaps too little care is exercised in determining quantities and materials. Or, either because of carelessness on the part of department heads in forecasting their needs, or lack of skill on the part of the purchasing agent, there may be periods of over—or under—stocking, the former meaning that an unnecessarily large amount of money is tied up in materials and supplies, and the latter requiring the payment of a higher price for especially quick delivery. The numbers of defects discovered after the material has been put in process may indicate careless inspection at the receiving station, which may be costing the company considerable sums of money. The use of tools should bear some definite relation to the use of materials; a variation may suggest theft, lack of care, or perhaps poor quality of tools purchased. Each one of these represents an element of cost, and yet not one of them is expressible in dollars and cents.

Essentials of Successful Organization

Statistics are comparative and statistical analysis is the proper correlation of all separate classes of facts so that like may be compared with like and differences in the results produced by the same causes may be measured to identify other factors which have controlled the operation of the fundamental causes. The part is compared to the whole to measure variations, and comparisons are made for a single group at different periods of time to disclose trends and tendencies.

Correct accounting would be impossible if the work of following each transaction from its inception to final disposition were not fully organized. What is true of accounting is also true of statistics; if the records of work performed, for instance, can be currently kept and their classification, summation and analyses made a part of the regular routine, the obtaining of useful statistics does not place a great burden upon the corporation. To accomplish this, however, a great deal of very careful planning is necessary. The units for each set of records must be clearly defined. The method of organization must be worked out so that delay, uncertainty, debate as to procedure or definition, may be eliminated.

Timeliness is essential to usefulness of statistics. Some statistics should be available daily, others weekly, others annually or semi-annually. At stated periods all of these must be gathered into extensive studies, and the analysis embodied in a report. Good organization, adequate training of employees, definiteness in method, absolute clearness of thought as to use and significance of reports, are necessary to ensure timeliness as well as utility.

Qualifications of the Statistician

All tabulations are not statistics, neither are all those who can "figure," statisticians. There are very well established statistical principles, processes and methods, and only one who is thoroughly trained in these is a competent statistician. To such a man should be entrusted the task of organizing and maintaining the statistical work of the corporation. He may also be an accountant, and the best accountant is he who is also a statistician (naturally so, if accounts are simply financial statistics). In some cases it may be practicable to place both the accounting and statistical departments under the same immediate head, but usually it will be best to make two separate departments of them, independently conducted, provided, however, that the work of both is planned so as to be complementary. This does not mean that the work of the accounting department must be duplicated or expense doubled; on the contrary, the planning of work along these lines will simplify many of the existing organizations and actually curtail expenses. Many corporations already maintain elaborate systems of individual reports and memoranda, which can very easily be improved and molded into comprehensive statistical control.

Correct Analysis and Skillful Presentation

Finally, the question of presentation of statistical data is important. The secret of a worth-while statistical organization depends upon the skill with which the many facts gathered from diverse sources can be resolved into a very few simple but highly significant figures. Each one of these figures will have voluminous data in support, but it is not necessary to set forth that detail in every case. The officers are interested in the net results, and these they must have in a form adapted to their use. The form of statement, the manner in which certain figures appear upon the sheet in relation to other facts, the columnar designations, etc., will very often indicate the meaning of the figures far more clearly than lengthy explanation. They must be so presented to be really useful.

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Ordnance Department Establishes Industrial Education Section

THE Army Ordnance Department announces the establishment of an Industrial Education Section for the purpose of increasing productive efforts in the plants engaged in the manufacture of Ordnance material.

The activities of the Section are under the direction of Major F. L. Thompson and Captain C. R. Dickinson, and will be aimed to carry home to the individual worker, be he employer or employee, the fact that his own personal efforts will have a direct bearing on the winning of the war. The agencies employed include posters, booklets, pay envelope stuffers, newspaper publicity, display advertising, motion pictures, public speakers and exhibits.

Posters carrying a message of encouragement to the worker tending to inspire greater individual effort are sent out to the manufacturing plants at regular intervals. Some of these, notably—"Not Just Hats Off To The Flag, But Sleeves Up For It," have been remarkably successful, according to the more than 900 letters received by the Ordnance Department regarding it.

Booklets and pay envelope stuffers are used to convey inspirational messages to the home and thereby tend to increase the morale of the community. An edition of 2,000,000 of one of the smallest posters ever issued, bearing a message to the individual was distributed in a number of cities on Labor Day by means of aeroplanes dropping them over the course of the parade.

In the same manner, speakers, many of them foreign soldiers returned from the Front, have been furnished to meetings of plant employees and have explained how necessary it is to speed up production.

Training Minor Executives In a Large Shoe Factory

By Roy Willmarth Kelly

The open door to advancement is one of the most powerful incentives before the workers in any industrial enterprise. But no one can pass through this open door unless he is properly prepared. So the management of a large New England shoe factory has put into effect a plan whereby naturally qualified and well trained persons are always ready to be transferred and promoted into executive positions.

Mr. Roy W. Kelly *has had extensive experience in technical and industrial training, including the positions of principal of the Technical High School, Fall River, Massachusetts, and director of vocational guidance in the prevocational schools of Boston, Massachusetts. He is now Director of the Bureau of Vocational Guidance of Harvard University and has charge of the War-Emergency Course in Employment Management.*

ONE of the most fundamental problems in management is that of provision for continuity in the life of the organization. Even in peace times, there are numerous factors operating to bring about changes in personnel and in policies. The varying ambitions and abilities of the working force are causes working all the time to disturb the existing arrangements, and give rise to readjustments in positions and methods of management. Real progress is possible only when transfers and promotions are made in such a way as to bring well trained and naturally qualified persons into executive positions. The preparation of minor executives has been neglected, as a rule, even in companies which have stressed the matter of the careful initial selection of employees.

The W. H. McElwain Co. of Manchester, N. H., believes that one of the greatest enemies to growth is the person who looks with contempt or disdain upon the ability of his followers to grow. One of the essential qualifications for the heads of large departments in their shoe factories is the ability to train and develop men.

Mr. W. L. Shaw, head of the planning division in this company's central plant at Manchester, outlines the situation as follows:

> The question of the absorption of new workers into an organization seems to me obviously one of the most important problems. I cannot see how any concern can survive permanently unless it constantly gives a great deal of thought to preparation for the future. Incidentally, I think that a great many people look upon organization as the science of grouping men for work. You find that in discussing the matter of organization they are inclined to consider it on that basis. They usually have a chart and will explain how the various divisions should be arranged, how the men should be grouped. These matters, it seems to me, comprise only a minor part of the whole problem. I have come to believe that I should be willing to let any man take a paper and arrange his men if I could have the job of defining what real organization means. Real organization means the development of fundamental principles of work. We have done a little along that line; we have arrived at the conclusion that organization is something deeper than the superficial connections among divisions and departments.
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> As an example, take nepotism—the placing of relatives in positions on account of their being relatives. I have seen many organizations entirely disrupted because the men who had been in them for many years failed to appreciate that nepotism might cause decay and death in the organization that they had spent their lives in building up. Nepotism poisons both the giver and the receiver. If the person succeeds, people will say, "Why shouldn't he—his father is pushing him"; and if he fails they will say, "If I did that, I would be fired."
>
> Think what it implies. It means that the person who has grown up in that business and has come up almost in reach of one of the leading positions suddenly finds that the manager is talking about his son who is going to be out of college next year. No matter what any one else does, the son is going to become the manager of that business. It is not surprising that occasionally you see very able men leaving that corporation and going elsewhere, sometimes at a lower salary. The man who has the son wonders what has happened. So, as the next step, he begins to lean more and more on his son. Shortly afterward you are likely to find disease all down through the organization.
>
> That is only one item out of many which should be included among the principles of organization. There are a great many other principles of equal significance; but that is enough to show that this is a very important study.
>
> If you take a young person who has had a very good general education and put him into a large organization, is it not very clear that the sooner you can give him some clear conceptions of how your concern is organized and what your policies and methods are, the quicker he is going to fall into line? And as soon as he has absorbed the technical details he is going to do better work and be much less liable to make errors which might cause trouble.
>
> In taking a new member into an organization a large part of the first week or two is usually absorbed in developing acquaintanceship with other individuals. As Mr. McElwain used to say, "It will take a month or so to let the new things soak in." The head of the instruction department which we have lately installed speeds up this process of introduction and "soaking in" instead of leaving it to be a matter of accident, depending largely upon the personality of the individual as to whether he does or does not become acquainted with the new surroundings.
>
> We first became interested in this phase of training in connection with job analysis. When we took up time-study work we first thought that we would permit well qualified workmen to be time-study men. This was a failure; they could not do it. We should first have had to give them courses in physics as well as arithmetic and other mathematics. After trying several men from the shops, we had to give up the idea.
>
> We next tried several graduates from technical colleges, but they proved equally hard to handle. They were unpopular with the workmen and were continually causing trouble because of their lack of sympathy with the worker's point of view, or because they did not understand our methods or policies. Finally, after watching their work, we concluded that the fundamental difficulty lay in certain essential matters which to us seemed obvious in our daily work.

Gathering Information as a Basis for Training.

Under the direction of the planning department, a man was then detailed to spend several months in collecting material which could be made the basis for training time-study men, technical persons for certain factory departments, and both men and women for the planning and employment departments. It became evident from the start that it would be almost an endless task to prepare all the instruction material in detailed form, so a loose-leaf syllabus, merely a check list of topics, was hit upon as the most desirable substitute. This plan made it possible to add material from time to time as regulations were changed, or as additional charts or illustrative material were prepared. The following paragraphs are contained in the introduction to the syllabus:

> A few statements are necessary in order to give one a clear idea of this binder. In the first place it is not a text book, but is a reference book for the instructor to use. To be sure, several parts of the book are given to the apprentice, such as the check lists, detailed instructions for time-study practice, etc., but these are given separately. The idea was primarily, to collect all the written data used in the course, and to put it in one place in usable form. In this way it was possible to simplify the instruction work, and put it in such form that another person could take up the instruction work without serious delay.
>
> The detailed factory check lists are complete for all factories, and are the best thing we know of for making sure that a man will get detailed knowledge of whatever particular department he will specialize in later. For example, if Mr. Brown wishes a man trained for upper leather work, that man will be given the check lists on upper leather and upper leather tannery to study, after completing the regular course. The man will take these check lists into the factories and will get all the information asked for in the items. When Mr. Brown gets the man, he can put him to work, knowing that he is prepared for it.
>
> No one person gets *all* the course. The writer is of the opinion that the work of the planning department will grow into the lines of investigation and research, rather than toward mere time-study work, and that to accomplish this, it will be necessary to have men who have a general knowledge of the whole business, and who have in addition a very detailed knowledge of some particular factory or department. We are trying to work along these lines now, and we believe that the department will be in a stronger position when we have in our organization a man who understands thoroughly each department of the business. This, however, will not narrow the men by too extreme specialization. As the first step toward this tentative plan, each man gets *one or two* of the detailed check lists and *no more*.
>
> It is understood, of course, that the material included in the syllabus does not indicate the amount of actual "laboratory" work done in the course. It is the plan to have each man get considerable working experience by doing layout work, process reports, findings tests, and time studies, while still under the supervision of the instructor. Whenever possible, such work is requested from the planning department managers and, therefore, time is not wasted in theoretical field work. As this work varies daily, it is obviously impossible to line up specific items to be done by the apprentices.

SUBJECTS IN THE TRAINING COURSE

The outline of the subjects covered by the training course is given below. Starred topics are taken up only by persons specially selected to do the work indicated. Thus the slide-rule instruction (topic No. 11) is usually given only to clerks or others who are required to make use of the slide rule in their daily work. A chart and condensed instructions regarding the use of the slide rule are provided with the thought of giving special help in multiplication and division. Similarly, the section on the "Theory of Employment and Labor Conditions" (topic No. 18) is given in detail only to persons who are likely to enter the employment department. The period of instruction usually lasts from one to three weeks, according to the range of subjects to be covered, the position for which the apprentice is being fitted, and the size of the class taking the course.

INSTRUCTION COURSE — OUTLINE OF SUBJECTS COVERED

A. Office and Class Room

1.	Instruction system.	Purpose and explanation of.
2.	W. H. McElwain Co.	History and organization.
3.	Planning department.	Organization, functions and routine.
4.	Foreman's instruction book.	Knowledge of contents.
5.	Company system.	Relation: Supply and shoe factories' sheet system, delivery calendars' tag system, abbreviation catalog.
6.	Order department.	Systems used.
7.	Fundamental ideas on which our work is based.	
8.	Personality.	
9.	Individual system and technique.	
10.	Tact and psychology.	
11.	* Slide rule.	Theory and practice.
12.	* Elements of time-study practice.	Theory and practice.
13.	* Finding's tests and layout work.	Theory and practical work.
14.	Preliminary instruction on shoe manufacturing.	Parts, methods of construction.
15.	Elements of report making.	Forms.
16.	* Drawing.	Free-hand. Mechanical. Diagrams. Graphic representation.
17.	Theory of organization and management.	
18.	* Theory of employment and labor conditions.	

B. Field Work

Shoe factory men	*Supply factory men*
Shoe factory visits, technical	Shoe factory visits, general
Supply factory visits, general	Supply factory visits, technical
Laboratory practice: Stitching Lasting Making Finish or tree	Laboratory practice: Sole leather Heel General or Tannery Upper-leather Cloth General
Criticism and correction of work.	Criticism and correction of work.

C. Follow-up

Talks with the man and with his manager, to keep track of work done, and to gather additional material for instruction wherever that is found to be necessary. It may be necessary to extend it over a period of two or three months, depending upon the employee's success.

METHOD OF INSTRUCTION

The course was first given by the man who had collected the material. In the process of his investigation, he had gathered a large fund of illustrations drawn from the experience of members of the company which could be used to advantage in teaching each topic. Organization charts, diagrams of machines and operations, and supplementary material from recent publications were also made a part of the subject matter.

To help the student in getting his first conceptions of the materials and methods involved in shoe manufacture, a small museum was prepared containing a series of exhibits dealing with each of the more important sections of the industry. The collection includes samples of various kinds of leather, shoes in every stage of construction, machine parts, and charts and diagrams of different processes. With such an exhibit at hand, it is relatively easy to explain the sources and uses of the different materials used in shoes, how the shoe is constructed, or the relative advantages and disadvantages of the welt and McKay processes. Explanations in work rooms are not always satisfactory, due to the noise, and protracted discussion is not desirable since it is likely to interfere with the regular routine of the shop. In this way, the student becomes acquainted with the more elementary phases of shoe manufacture before entering the plant on an instructional visit and his time can be spent to much better advantage.

As the outline suggests, visits to various parts of the shoe factory, or to the factories manufacturing supplies, constitute an important section of the course. Each visit is made with certain definite objects in mind, and the student has at hand a list of matters to which he must devote his attention.

The instruction department also contains the plant library, dealing with such topics as scientific management, industrial organization, business systems, employment management, and other subjects of interest to executives and progressive workmen. The head of the department is expected to keep in touch with important additions to the literature of these fields and to assist the members of the organization in finding books or articles bearing upon their immediate problems.

At present, the instruction is being given very successfully by a young woman, a college graduate, who studied the course and various departments of the plant in an intensive manner for some months.

THE PURPOSE OF THE CHECK LIST SHEETS

An examination of the sample sheets from the check list, reproduced herewith, will show that many of the points considered are of the kind about which the employee in most concerns either receives no instruction, or is expected to gather his information in haphazard ways. The sheet on "Company System" suggests a variety of problems which are sure to confront any executive, even in a minor position, and concerning which he should be thoroughly intelligent if he is to render efficient service. This sheet is only one of several in the binder, all devoted to the general subject of the organization and system of the company.

Much attention is given to matters of personality and individual system and technique. A pointed warning for the new employee is contained in such topics as "talking for personal effect: statements which may be taken by other members of the organization as a direct or indirect 'attempt to climb' "; "bubbling talk"; "constructive versus destructive criticism"; "definite plans for utilizing spare time"; "discussion of company's plans with outsiders"; "acknowledgment of the plans of other employees."

A frank discussion of such questions with a capable instructor saves many young men and women from needless blunders. Furthermore, criticisms and discipline are rendered much more effective when the one at fault can be confronted with the fact that he has been properly instructed and given fair warning.

Each student learns something of the "psychology of specific approach." If he has matters to bring before an executive, or a report to make, he is taught how to organize his material and learns something of the knack of gaining concentrated attention by holding himself strictly to the topics in hand.

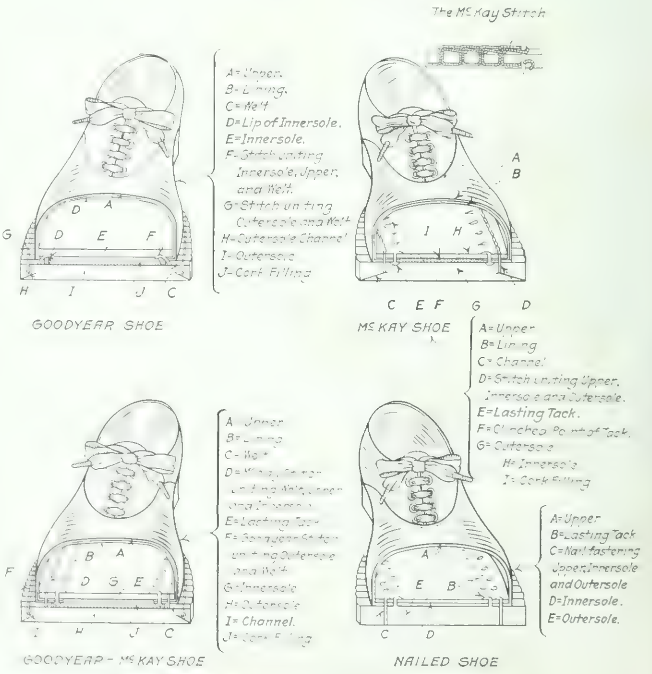
Such a system of training renders distinct vocational guidance service to the employment department. As a rule, those who are enrolled for the general course are not told what department they are being prepared for until the work is completed. This gives opportunity for a period of observation of the students by the instructor and observation of the students by the instructor and members of the planning and employment departments, who are thus in a position to place the candidates to better advantage.

THE FINAL EXAMINATION

TWO STUDENTS AND THE INSTRUCTOR AT WORK IN [illegible]

The only feature of the course open to serious question in point of method arises in this connection. A written examination lasting about four hours is given at the end of the course. It is intended to serve as a further gage of the apprentice's adaptability and of his readiness to undertake any particular responsibility. The claim is made that unsatisfactory candidates thus have an opportunity to prove their inefficiency before they are assigned to important positions and they can be dropped from the department at once instead of after four or five weeks of unsatisfactory work. Several objections may be urged to such an examination. Many very capable persons write a poor examination paper, especially under conditions such as would obtain here where the candidate's means of livelihood is more or less at stake. Shorter examinations at intervals, written reports on selected topics, personal conferences, the preparation of a note-book, and other means which will suggest themselves at once to any instructor would probably answer the purpose equally well and at the same time relieve the apprentice of the strain of facing a "final examination."

One naturally looks to the records of its graduates as the acid test of a school's efficiency. The statement is made by the department that has this work



SHOE CONSTRUCTION SHOWN IN FOUR DIFFERENT TYPES in charge at the W. H. McElwain Co. that the progress of employees who have taken these instruction courses is on the average twice as fast as in the case of those who entered the organization without any preliminary training. No better proof of successful accomplishment could be asked.

Any educational experiment of the sort described above is particularly to be welcomed at a time when every effort ought to be put forth to make the best use of our man power in production. The principles involved have a direct application to concerns of every kind, and the method is sufficiently flexible to permit its ready adaptation to any kind of work or to any type of organization.

Written specifications for hiring, job analyses, written standard procedures, accident reports, organization charts, and a variety of other material is already available in many concerns as a basis upon which the subject matter for instruction can be built.

The results of the work in the W. H. McElwain Co. show quite clearly that organizing and teaching ability are required in the instructor rather than extensive technical experience. The technical part of the instruction is supplemented by contact with the shops and by foremen and others who are experts in their respective fields. These considerations would appear to decrease considerably the difficulty which most firms would anticipate in finding persons who were capable of managing a training course for minor executives. In many respects the problem appears to be somewhat simpler than that of obtaining instructors to train workmen or operatives where technical trade knowledge and skill, usually the product only of long experience, must be combined with teaching ability.

EXTRACTS FROM INSTRUCTION SYSTEM: CHECK LIST

Company System.

Sheet system and production system.
Run: Meaning of.
Sheet: Description of.
    Method of numbering.
Case: Regular, definition of.
    Sample, definition of.
    Model, definition of.
    Hurry, definition of.
    Method of numbering, all kinds.
Size of sheet: How determined.
Size of cases: Maximum and minimum.
    Average factory run.
Checking sheet: Explanation of.
Checking sheet: For hurries.
Analysis sheet: Explanation of.

Company plan for manufacturing: Shoe factories and supply factories.

Relationship: Shoe factories and supply factories.

Time chart: Supply factory items: Inspect.

Delivery calendar: Explanation of: Purpose of.

Shoe factories only; Box system: Explanation of; Bulk system: Explanation of.

Box System

Box system: Method of routing work.
    Vamps, tops, lining.
Disc system: Description of.
    Stitch room.
    Lasting room
    Sole lasting to packing.
    Special for McKay stock fitting.
    Study binder 3250 and charts.
Hourly production reports: Purpose of.
Station reports: Where taken.
    Purpose of.
    Inspect charts showing location of stations.

Individual System and Technique

Personal system: What we mean by: Value of advice on.

Attendance: Punctuality of: Strict adherence to: Necessity for: Hours to be observed: Factory and office.

Sickness or indisposition: Working during: Effect on department standard: Advice on.

Overtime work: Policy of department regarding and exceptions.

Office routine: Planning department office: Instruction on: Mail: Filing: Stenographic service: Traffic service, etc.

Stationery: Kinds available and generally used: Method of ordering.

Notebook: Personal pocket: Adoption of plan and get book: Use of.

Tickler system: Explanation of: Extreme value and importance of: Detailed use of.

Ticklers: Make tickler for every paper, letter, or duty that is entrusted to your care: Keep tickler working until matter is finally disposed of.

Ticklers: Look at first thing every morning.

System: Personal: Desk neatness: Standards of company: Material to keep in desk:

(1) Work ahead.
    a. Immediate.
    b. Future.
(2) Work in process.
(3) Completed matters, ready for file or mail.
(4) Working tools, stationery, pencils, etc. Everything else in tickler or department file.

Acknowledgment: Necessity of answering all memos and requests at once even if only for postponement.

Delivery of work on time: Personal and departmental policy: Rule on: Necessity for strict adherence to date of completion.

Delivery of work on time: Habit of asking for specific completion date.

Orders: Carrying out of when known to be wrong: Policy regarding.

Binder system: Specific detailed instructions and method of handling papers.

Expense account: Personal: General system and method of rendering and cashing.

Expenses: Explanation of department policy: As determined by work at point of residence and while away from residence.

SECONDARY DETAILED DEPARTMENT VISITS

Sole leather, Department 14, McKay innersole department, check, notes.

1. McKay innersoles: Difference between Goodyear and McKay.
2. Kinds of McKay innersoles: Description of solid, doubled, pieced, etc.
3. Leatherboard: Kinds used, thickness used, purpose of leatherboard.
4. Leatherboard cutting: Dies used, thickness cut.
5. Put away doublers: Location in racks.
6. McKay innersoles: Cut department 5, storage in racks.
7. Make up lots: Size of lot, method of making up lot.
8. Double by hand: Method.
9. Press innersoles: Method, reason for.
10. Double alsop: Study machine action, study operation.
11. Paste toe doublers: Reason for toe doublers: How cut, how put on innersole.

* * * *

Limitations Upon Storage of Bituminous Coal by Industrial Plants

THE tremendously increasing demand for coal for special war purposes in the Eastern part of the country, particularly for the Navy and Transport Service, is making it necessary to draw more heavily on the Eastern coal fields than was originally contemplated.

United States Fuel Administrator Garfield has announced the basic policy of the Fuel Administration as to storage as follows:

"Coal in excess of that required for current operations shall be delivered to plants not on the Preference List of the War Industries Board only when it is not in demand for use before April 1, 1919, by consumers on said list, namely, railroads, the Federal Government, states, counties, public utilities, retail dealers, or manufacturing plants on the Preference List. * * *

"Allowance shall be made for differences in distance from the mines and for differences in transportation."

Hardships of the Cost-Plus Plan

By J. P. Brooks

Vice-President and General Manager,

The Cleveland Automatic Machine Company

IS it not about time that a general protest was made to our Government to stop or modify the destructive cost-plus way of doing business in the midst of this great war, when all business men are called upon to exert themselves in every way possible to assist the Government regardless of whether they are doing government work or not. Manufacturers of machine tools and other kinds of machinery are helpless when cost-plus contracts are encouraged in their vicinities.

Imagine a company producing war material being allowed to pay from $10 a day up to an ordinary mechanic. Do not forget that the higher the wages under this plan the greater is the income of the contractor.

Was there ever such an injustice from the standpoint of fair play to the man who cannot pay such wages? There are thousands in this country who cannot commence to compete against such a one-sided, unbusinesslike manner of doing things. When you consider that our Government seems to sanction this destructive plan, most likely unconscious of its effects, the situation really seems incomprehensible—yet millions of dollars are being spent with companies who obtain Government work on the basis of "cost-plus." The greater your payroll the larger your income is the foundation of the cost-plus scheme.

How Private Business Suffers

If you have a factory with a thousand or more men in your employ, to whom you are paying say from $5.50 to $7.50 a day, they are approached and informed that they can earn $10 a day on government work, so they leave you and the consequence is legitimate business suffers and the cost-plus man smiles. Uncle Sam seems to forget many lines of business that are essential at this time, and helps create an insurmountable difficulty to retaining your skilled men.

It seems to me that this is about as unjust to the thousands of companies who have no alternative but to allow their best men to go, as it would be to withdraw from the war and allow the Kaiser to rule the world. We all know what a dastardly act that would be.

Suppose all the builders of machinery were to organize for self-protection to meet this wage competition of cost-plus and pay $10 to $12 a day and agree to raise their prices say 75 per cent. This would be nothing but fair and just. What would happen? The Government would consider this a trust and the cry would go up that we were trying to make enormous profits at the expense of the people all because of the war, which, of course, would not be true.

Machinery Prices Must Increase

War profiteers, you know, are supposed to be suppressed. Nevertheless, this cost-plus way of working is a dangerous plan. If it continues the price of machinery must be raised for wages are going to increase, because the cost-plus way of doing business is forcing us to pay extremely abnormal wages and the country in general will be the loser.

If the profits of general business are lessened the income tax will drop deplorably, and the expenses of this war through cost-plus will increase millions of dollars more than necessary. All this is because of an unbusinesslike manner of doing things, which means pay as much wages as you like, pay as high prices for your material as you can, and the Government will return it all to you with a percentage of profit.

This plan brings near disaster to those who happen to be in a staple business, and who are not in a position to raise their prices because of competition. The plan might be termed a scheme to allow some business men, to have all kinds of freedom and lack of restraint and do a great injustice to others.

Cost-Plus Plan Works Hardship to Established Manufacturers

This cost-plus idea is not competitive. It encourages recklessness by increasing the price of the Government's requirements and in so doing, when considering labor, it discriminates in favor of the man who is lucky in obtaining employment in a cost-plus factory. It shows a Government weakness that should not exist for the reason that it follows the path of least resistance and this means recklessness—an attitude that from a dollar standpoint should never exist, least of all at this time.

It is true we must produce what the Government must have and do it rapidly. But this can be accomplished by a stricter control of labor and the manufacturers working on direct war work. And every effort must be made not to injure the great multitude of substantial business houses not engaged chiefly on war work, by paying exorbitant wages that cannot be met by the general run of factories.

When the Government calls for fighting men and the necessary money to maintain them successfully, we must all fall in line gracefullly because it is a solemn duty. But when hundreds of substantial manufacturers are forced to compete in the labor market against our own Government with no possible chance of success, the situation is certainly discouraging, also terribly damaging, and deserves the attention of those who have the power to correct this one-sided plan. All lines of business that are essential to winning this war should be encouraged and not interfered with.

Right here in Cleveland we are feeling a sting of the cost-plus way of doing things, and if the difficulty continues and increases, the time will arrive when many will be forced to slow up, all because good judgment is not being exercised in handling the labor problems with justice to all.

Standard Wages on Government Work

A remedy should be forthcoming to standardize wages on all Government work the same as the railroads are controlled in this respect, and give every business man a fair deal. The cost-plus plan works fine for the company who enjoys a contract on the cost-plus basis, but the other fellow, who is trying to return or obtain help and cannot afford to pay such high wages, is helpless. He is damaged by the cost-minus plan and has no alternative. We must not lose sight of the fact that the great multitude of machine and equipment manufacturers should be helped in every way possible, fully as much as the men who are actually producing directly for the Government. They are just as essential in the final analysis.

We must all pull together from a business standpoint if we are going to hasten the defeat of our most dangerous enemy. But if this war continues for some time and the cost-plus idea is forced, near failures will occur without question, and these will be a national catastrophe at this time.

Mastering Power Production—IX

Principle of Essential Cost and Use of Standard Cost

By Walter N. Polakov

In reaching toward the new ideal of making commodities cheap and men dear, the author clearly presents the principle that unnecessary expenses incurred by the manufacturer or financier must not be charged back to the consumer. To obtain a proper cost, a standard cost taking into consideration all the surrounding conditions must be predetermined and records of performance—preferably graphic—compared each month with the standard cost. This method supplies the spur and points the way to improvement.

Mr. Walter N. Polakov *is a consulting engineer, specializing in the management of power plants. He was educated in Russia and Germany, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he was consulting engineer to the Board of Estimate and Apportionment of New York City, consulting engineer for the Penn Central Light & Power Company and Superintendent of Power of the New York, New Haven & Hartford Railroad Company.*

THE fetishism of money power is rapidly vanishing as the clear conception is gained that it is labor-power that produces all commodities and creates all wealth. All the natural resources of a country are void of any value until labor is applied to them and they are put to a definite use. The value of every commodity is in proportion to the time rate of labor power expended in its production. Insofar as money is a convenient equivalent of labor-power, the expenditure of money is commensurate with the expenditure of labor-power and, therefore, excessive cost of production spells inefficiently applied labor. In other words, high cost of production is a result of waste. Waste of materials means waste of time and labor spent for its mining or preparation, or manufacture and delivery, though it is reckoned only in terms of money paid for misused materials. Similarly, the use of a larger plant or machine than the output or product calls for, represents the waste of the labor power required for its construction, maintenance and operation, though such a form of waste appears as innocent as a sleeping babe. In this sense the over-expenditure of money is just as vicious a social crime as arson, sabotage, lockout, or any other wilful restriction of production—for it destroys productive effort applied at one time or another, or, at least, diverts or limits its application to some useless purpose. The old fallacy that one can spend his money as he pleases does not hold any longer, since money spent to no purpose means waste of natural resources and of labor-power. Similarly, idle money means restricted production and limited satisfaction of wants and needs.

In the manufacture of power it is particularly important not to lose sight of these fundamental economic principles as power, unlike many other commodities, once wasted cannot be recovered for practical purposes in the form of scrap, by-product or salvage. While the energy of the universe remains constant the entropy approaches a maximum.

The fact that matter is neither created nor annihilated, and that energy merely changes its form in the universe but is not destroyed, may be of practical help to us only upon our attaining immortality. So long, however, as the years of our life are numbered, the water running over the dam and the heat from coal passing up the chimney do concern us most vitally, for expenditures of such a nature cannot yield a return unless this released energy is worked up into a useful and usable commodity.

This point, unfortunately, is often overlooked by those whose business it is to control expenditures, and the common fault of the financiers of the beginning of the twentieth century was that they did not separate expenditures necessary for the production of goods from those incurred through mismanagement, nor from those that did not add anything to the quality or speed of production. Those men have a wider vision now.

Cost Versus Expense

While it has been customary to appoint guardians for incompetents, minors and wastrels, and to institute receiverships for business concerns failing to meet their financial obligations, hitherto we have been slow to realize the necessity of the social control over undertakings producing dear commodities. It is obvious that a plant consuming twice the necessary amount of fuel to generate electricity has a bus-bar cost higher than it would be if properly managed; that the plant employing two 12-hour shifts of men cannot secure the same economy as one working three 8-hour shifts; that the plant operating on full load only for short intervals consumes more steam, burns more fuel and carries higher operating charges per unit of output than another operated continually at a favorable load. Yet we continue to insist that public service commissions must not interfere so long as the public gets satisfactory service at a "reasonable" rate. The fatal misconception of what constitutes the cost of a commodity is primarily due to the confusion of necessary and unnecessary expenses. As soon as a clear conception is gained as to what expenditures are actually necessary for an efficient production a distinction between the actual cost of production and merely accompanying expenses may be gained.

Let us take, for example, a 50,000 kw. plant valued at $5,000,000 with an actual output of 200,000,000 kw. hr. per year, consuming 3.5 pounds of coal per kw. hr. and reporting its expenses as follows:

Fuel	$1,050,000
Payroll	56,000
Supplies	6,000
Maintenance	72,000
Fixed charges	500,000
Administrative expenses	175,000
Total	$1,859.000

This plant is capable of producing safely 350,000,000 kw hr. per year using two pounds of the same kind of coal per kw. hr. Thus the output of the plant is only 57 per cent. of its capacity. Yet its actual coal consumption would be sufficient to generate full output, and its payroll, fixed charges and administrative expenses remain the same whether the output is 200,000,000 or 350,000,000 kw. hr. In such a case the comparison of unit costs per kw. hr. would appear as follows:

Expenses per kw. hr. in cents.

	200,000,000 kw.hr.	350,000,000 kw.hr.
Fuel	0.525	0.300
Payroll	.028	0.016
Supplies	.003	0.002
Maintenance	.036	0.021
Total	0.592	0.339
Fixed Charges	0.250	0.143
Administration	0.088	0.050
Grand total	0.930	0.532

Inasmuch as 15 per cent. net saving on fuel is entirely possible in this case 0.078 cent is spent unnecessarily in producing each kw. hr. and neither the consumer nor the country gets any advantage therefrom. Furthermore, the fact that $675,000 is a necessary money outlay for the entire plant does not mean that the limited output should bear the entire charge, while the customers get the benefit of only four-sevenths of the plant. The unnecessary expenses per kw. hr. from which the public gets no benefit appear as follows:

Waste of fuel	0.078
Excessive plant	0.107
Pro rata of administration	0.038
Total waste expense per kw. hr.	0.223 cents

The real cost of each kw. hr. of the 200,000,000 output is therefore but 0.930 — 0.223 = 0.707 cent. In this case the expenses are over 30 per cent. higher than the true cost of the commodity.

If this obvious method of reasoning were laid down as a basis for cost-keeping and the rate-making or price-fixing principle recognized that the consumer cannot be charged for the unnecessary expenses incurred by the manufacturer and his financiers, the economic results would be far-reaching and beneficial for all concerned.

From this standpoint, the manufacturers of power or any other commodity have to accept the expenses of waste and idleness on their own account instead of forcing the consumer to pay for inefficiency of management, poor judgment or future expectations from which no one but the investor can benefit.

The advantages derived from such a plan are shared by both investors and consumers. An accurate knowledge of the excess of expenses over the necessary cost of production, leads almost inevitably to the discovery of means for eliminating this waste. The resulting reduced rates or selling price do stimulate the demand for the commodity. An increased output not only improves the power factor, the water rate of the turbines and the all-around efficiency, but also absorbs the idle charges accumulating on the unutilized portion of the plant. Again a larger output per unit of time means a faster turnover of the working capital, and even a smaller rate of profit results in a larger amount of income per year. An increased net revenue, in turn, makes possible a further betterment of plant and improvement of methods, and, if the demand, due to reduced price of service, is not yet satisfied, a further enlargement of the capacity of the plant is possible.

Economists of the Marxian school who forecasted the abolition of private ownership of the means of production—among other reasons on the ground that the rate of profit fell as rapidly as automatic processes reduced the profit-yielding portion of the capital used to pay for labor—were apparently supported in their premises by the entire economic trend of the past. This eventuality would have been realized before, were it not for the unprecedented increase of productivity with the limit of satisfied demand still beyond our horizon. Periodic business depressions, of course, signify merely a reduced purchasing power of society and in no way indicate that the needs of every individual are satisfied, nor that necessary production may not be expanded.

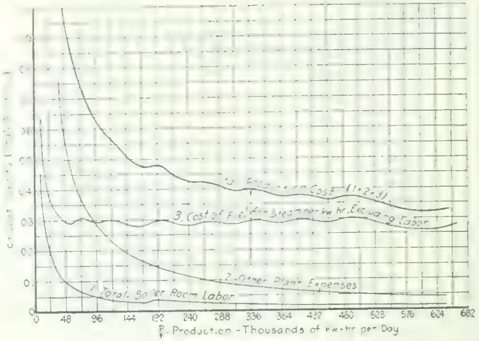


FIG. 36. COMPARISON OF VARIATION OF STANDARD POWER COSTS AT LARGE ELECTRIC RAILWAY PLANT

The significant feature of our old economic regime was the practice of producing commodities at any cost, not at a cost, and adding a profit on top of whatever expenses were incurred in production. At the same time the tendency in determining wages, *i. e.*, the purchasing power of the great majority of the consuming population, was to keep them at the lowest level that would provide the mere necessities of existence.

THE NEW IDEAL

The substitution of a new ideal, *to make commodities cheap and men dear*, will of necessity stimulate production by creating an unprecedented demand for cheap goods by well paid people. To show whether the adoption of this policy will delay or accelerate the public ownership of means of production is beyond the scope of this article. It is obvious, nevertheless, that *only an increase of the efficiency of productive processes is capable of ultimately reducing the price of commodities and increasing the earning power of employees.*[1]

RELATION BETWEEN EFFICIENCY AND COST

The relation between efficiency and cost must be established and understood before any attempt is made to control production. Generally speaking the higher the thermal efficiency of a plant, the higher is the operating economy. This, however, is not always true. Other conditions remaining constant, a plant may secure a higher efficiency of some partial process at an expenditure exceeding the advantages derived from the increased efficiency; again, it may be found that a sacrifice of thermal efficiency may yield larger financial returns if a quicker turnover of the capital is thus secured. To illustrate: An improvement of vacuum from 29 to 30 inches of mercury will require an additional steam consumption in the auxiliaries, an extra amount of water and probably increased overhead charges on improved equipment, all of which taken together would cost more than the value of the steam. Again, if the maximum boiler and furnace efficiency is, say, at 100 per cent. rating, while at 150 per cent. it

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[1] "Any attempt to achieve full efficiency in production and distribution which does not have as its paramount aim the cheapening of the product to the consumer will fail, and deservedly fail, through the revolt of the consumer."
London Economist.

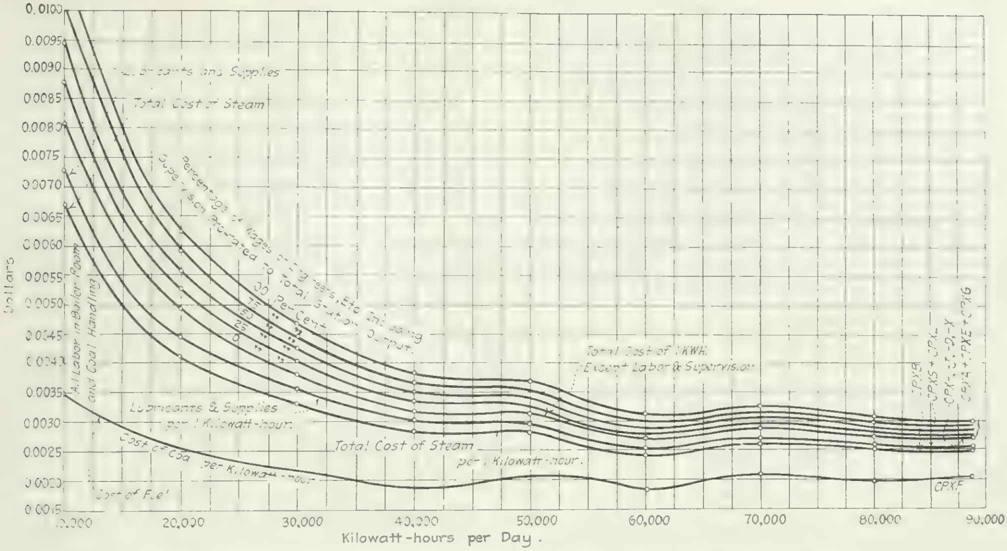

FIG. 37. STANDARD COST OF ONE KILOWATT-HOUR AT A PUBLIC UTILITY STEAM POWER STATION

drops 10 per cent., it might be found that the cost of the additional coal wasted is either smaller, equal to, or larger than the saving on rent, depreciation, interest and payroll if the boiler plant should be enlarged by as much as 50 per cent.

In other words, the apparent advantages of low thermal efficiency are not real, and are due only to our financial system which derives benefits not only from service to the society but from the destruction of our natural resources as well. The same paradox is evident in the case of economy in wages. While lower rates paid to employees, or longer hours of work, reduce the total payroll and apparently increase the economy, eventually they undermine not only the prosperity of the nation by creating dissatisfaction, increasing the death rate, lowering standards of health, reducing the buying ability of the people, retarding intellectual development, etc., but even affect immediately the concern practicing such a form of economy. A low rate of wages attracts none but the poorest grade of help, long hours rapidly depreciate the physical and mental value of workers, and the quick and inevitable result is a low operating efficiency and liability for hazards.

In this case again the entire country pays with its man resources and its natural resources, sacrificed for the sake of immediate concentration of gold in the hands of those practicing such forms of economy.

Thus we arrive at the double conception of the criterion of economy: individualistic and social. While the individualistic conception of economy in production admits of *waste and losses as revenue producing means* and introduces a conflict between economy and efficiency, economy in its broad national aspect explodes the paradox that it is profitable to waste labor and material since true economy permits only the *most efficient utilization of manpower and natural resources.*

So long as public service commissions aim to serve the interests of the people (public) it is impossible for them to regulate the rates and service rendered by utility companies without examining the methods of power production and their effect on the cost. Moreover, inquiry into "reasonability" of rates cannot be intelligently made unless a clear distinction is drawn between necessary and unnecessary expenses. Most of the prescribed methods of cost-keeping and accounting do not offer any opportunity for such an important differentiation, but even if they did provide for the segregation of the expenses from which the public does not derive any benefit, the rest of the expenses, ostensibly applied to the production, transformation, distribution and sale of power may, and actually do, include a certain proportion of waste. To determine the extent of this waste of public money (paid for destroyed natural resources and wasted labor) an accurate measure is necessary. It should be the task of public service commissions to determine for each utility plant and each district, a schedule of standard costs based on the best engineering and managerial practice and adjustable for any demand, output, price of labor and materials, etc., and to use this measure in monthly analyses of cost reports submitted by utility companies. Until the public service commissions are ready to render this service to the community which supports them, they are not fulfilling their duty, since their rulings are not necessarily based on indisputable facts, but largely upon presentations of the case by conflicting parties.

Predetermination of Costs

At the January meeting of the American Society of Mechanical Engineers in 1916, the writer presented a paper on "Standardization of Power Plant Costs," broadly quoted since[2] but largely misunderstood. The aim was to present a method by which it may be possible to judge *how close the actual production performance of the plant is to the possible minimum cost* at any time and under any circumstances, all the variable factors beyond the operating control being adjusted.

This *possible minimum cost* serves as a measure of the economic perfection of operation. Obviously, the physical, local, and other dissimilarities of plants would not permit the adoption of a uniform scale applicable to each and every one, but for any particular plant, taking into account all its specific peculiarities, it is feasible and comparatively easy to determine the individual standard of economic operation, which may be termed the *standard cost.*

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[2] "Bookkeeping and Cost Accounting," by Wm. Kent, "Lefax," and others.

The interplay of three factors, *time, product* and *cost* gives the criterion of economy. When only one factor varies its effect on economy can easily be foreseen. Thus greater production without change of required time or additional cost increases the economy. Increase of cost without a corresponding increase of production or decrease of time required for production reduces the economy. Commonly all the factors vary simultaneously, in which case the analysis of the equation of economy criterion

$$e = \frac{P}{ct}$$

can be made for any influential element n, and the increase of economy for a unit increase n, if differentiated, is:

$$\frac{P}{ct} \quad \frac{P'n}{P} - \frac{c'n}{c} - \frac{t'n}{t}$$

where all the elements are essentially positive.[3] Such a general study can be made with respect to economy if more than one influential element is involved as simultaneous equations for each can be written. The graphic method offers, however, an easier means of solving the problem. To determine the economic limit reached by continuous increase or decrease of influential elements is by no means an easy problem, but unless it is solved we are in the dark, not only as to *what economy can be obtained* but also *what changes in conditions and methods are essential to attain the desired degree of economy.* The analysis of the effect of the variations of these elements involved in the determination of the *maximum limit of economy* and corresponding *standard cost* for any one plant, can be compared to a determination of the height of the apex of a hill by taking altitude readings on both slopes in one direction and then repeating observations crosswise.

It is relatively unimportant whether the maximum limit of economy is determined empirically by rigorous observations, tests and analyses of all influential elements, or calculated from the principal data already available. But it is imperative that such a study be made and the economy limit established, as this is the only criterion for judging actual performance. Carrying out the analysis of the economy limit to its logical conclusion, the standard cost of product is arrived at. Evidently during such an investigation, not only are the itemized costs of individual partial processes found, but the conditions and methods whereby the standard cost can be attained are likewise established. In other words, unless the standard costs are established there is no measure of existing losses or exact knowledge how to eliminate them.

Manifestly, in the course of determining a standard operating cost, such factors as the inherent efficiency of equipment, its efficiency under different loads, prices of fuel and supplies, number of necessary and sufficient attendants and their compensation, etc., are taken into consideration for a given plant. Any deviation observed between the actual operating cost and this standard cost indicates that some of the necessary conditions were not lived up to and, if standardization has been carried out in sufficient detail, leads directly to the allocation of the loss to operating methods. On the other hand, if any change in the basic data used in determining the standard cost is discovered, an adjustment of the standard cost can easily be made before the blame is put at the door of the operating staff. The efficiency of the thermodynamic process, which largely influences the operating cost in a power plant should be made the subject of a most thorough investigation to ascertain, first, the maximum efficiency limit of each partial process, and, second, the result of their interplay. When this is accomplished, the entire process should be re-studied for the purpose of standardizing methods and adjusting for such a balance of efficiencies of the partial processes as will secure the maximum economy for the expenditure of time, energy and money involved. When all limiting conditions have been studied and determined, a method can then be defined for each member of the working force prescribing his duties and the conditions he must maintain to secure the most profitable degree of efficiency.

Upon the conclusion of these studies, the best efficiency of each unit and the combination being known for any load, the standard cost for any output in a given time unit can be represented graphically.

The principles for determining the standard cost of maintenance and upkeep of the plant and equipment are substantially the same; the method of study, however, is somewhat different. It involves a study of the design and construction of all the elements of the equipment, for minute records of their service and cost of maintenance may lead to a modification of design, use of cheaper renewable parts, etc. Next, the standardization of supplies, beginning in the laboratory and followed by actual service tests, helps to determine not alone the purchase price but the lowest service cost. Finally, time studies embracing schedule for inspection, routes for maintenance men, standardization of tools, motions, methods, etc., conclude the investigation. The criterion is, of course, not the wages of the employee, but freedom from accidents, breakdowns and the lowest attainable cost of upkeep per unit of the plant's output. It is evident that there may not be any theoretically certain standard cost of maintenance, but an empirical standard thus developed is generally but a fraction of the best actual record of the past

CURVES OF STANDARD COSTS

Upon conclusion of this double analysis of the maximum obtainable economy, the graphs of standard cost of power production may be drawn. Curves may be conveniently arranged with co-ordinates of cost, c, and product per unit of time, $\frac{P}{t}$ (output.) It will then be noted that the time element is one of the most influential factors in power economy. Whereas, in some cases where the number of generating units is large, the coal-rate per unit of output remains fairly flat and the other items of cost reduce rapidly with increased production per unit of time, in other cases the standard cost of fuel also decreases as the time is reduced during which a certain output is produced. Figures 36 and 37 represent curves of standard operating costs. It is evident that any number of curves may be plotted following the above method, each curve representing an itemized standard cost according to the adopted classification. Figure 37 is prepared for a medium sized public utility central station. It shows the variations of standard costs of coal, boiler-room labor, water, supplies, engineers and supervision per kilowatt-hour at various monthly outputs. This plant comprises four

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[3] See "Commercial Economy in Steam and Other Thermal Power Plants," by Robert H. Smith.

600-hp. boilers and three turbo generators, one of 2,500 k.v.a. and two of 500 k.v.a. rating; it operates 24 hours per day, seven days a week.

TABLE I

THE ——— COMPANY

POWER PLANT COST ANALYSIS REPORT

MONTH MAY, 1918

Total Coal Used	1910 Tons
Total Steam Generated	24,212,299 Lbs.
Average Boiler Efficiency	51.2 Per Cent

	Labor	Material	Total	Unit Cost	Standard
HDA **Total administration**			$1,137.14	Per 1,000 lbs. Steam 1.9c. (4.6c.)	955.55 (year average)
A Foremanship			426.37		
B -Business expenses			54.44		
E -Experiments					
C—Fixed charges			319.55		
H Light and power in power house			31.09		
R—Reclamation					
W Labor			2.98		
S—Supplies	$210 00	$92.60	302.80		
Y—Yard					
Z—Rearrangement					
X Credit					
HDM—**Total maintenance**			$614.82	2.5c.	$500.00 (year average)
C—Coaling equipment	$30.00	$17.31	47.61		
D—Distributing system	15.50	50.00	65.50		
B Boilers and auxiliaries	211.45	112.35	323.80		
G—Generating turbines, auxiliary	6.10	9.09	15.19		
A—Air compressors	64.60	40.08	104.68		
R- Refrigerating equipment	7.50	.42	7.92		
H Hydraulic machinery					
P -HP piping	12.40	8.11	20.51		
S—Switchboard and transmission	1.68		1.68		
M - Meters	8.09	2.00	10.09		
T—Tools and implements	.14	14.60	14.74		
F—Furniture and fixtures					
W—Heating and seasoning equipment					
Z—Buildings	3.10		3.10		
X—Credit					
MAIN POWER HOUSE					
HDO—**Total operation**			11,212.76	46.3	$9,792.25 40.4
F—Coal			6,717.59		4,800.00
W—Water			1,534.73		1,534.73
B Boiler room wages	2,083.79		2,083.79		2,470.00
E -Engine room wages	443.64		443.64		865.52
L—Lubricants and wastes			4.09		22.00
S—Supplies, miscellaneous					100.00
U—Unclassified expenses	210.60		428.92		
X—Credit					
HD—**Total Main Power Plant Production**			12,964.22	(53.4c.)	11,247.80
Less Idleness in Main Plant			693.66	50.7c.	46.5
Auxiliary Plant No. 1					
Fuel		$93.60			
Boiler-room wages	$144.05				
Boiler maintenance and supplies	123.50	40.41	401.56		
Auxiliary Plant No. 2					
Fuel		46.80			
Boiler-room wages	279.06				
Boiler maintenance and supplies			325.86		
Auxiliary Plant No. 3					
Fuel					
Boiler-room wages	290.27				
Boiler maintenance and supplies			290.27		
HD—**Total charge to Manufacturing Departments**			1,017.69		
Total expense of H. D. Department			13,982.18		

From this diagram it appears that the cost of coal per kilowatt-hour is lowest when the output of the plant is approximately 1,900,000 kw. hr. per month. A further increase of output coincides with an increased cost for the fuel required, due to the characteristic of boilers and turbines, that their efficiency drops at the higher rates of loading. Again, costs of labor, supplies, etc., per kilowatt-hour, which drop more rapidly than the cost of fuel rises, offset the difference and render a greater monthly output more desirable economically. Even there, however, we meet a limit when at the rate of 2,200,000 kw. hr. per month the unit cost becomes higher than it was at the lower output of 1,900,000 kw. hr. per month.

Figure 36 illustrates a few characteristic curves of standard cost per kilowatt-hour for various rates of output of a large central station feeding the lines of an electrified trunk railroad. The plurality of waves on the fuel cost curve is due to the increased water rates of the turbines every time an additional unit is switched in to take care of increased load. Again the steam consumption is reduced thus bringing down the cost-curve as the load on the turbines in the line reaches a more economical point. The tendency of the total standard cost to go steadily downward with an increase of the output rate is due to the plurality of generating units. The practical use of such predetermined standard costs can be made extremely simple by the use of these graphs. For busy executives or owners, the entire cost record visualized by graphical representations of the items is found very convenient. Examples of such graphs are seen in Figures 39 and 40, wherein the actual unit cost and the standard unit cost are plotted to the same scale; the deviation of one from the other suggests at a glance the degree of perfection of the performance. The total expense curve and the cumulative expense curve may be shown on the same graph to a suitable scale; the latter curve is found very serviceable for comparing these items with the appropriation made. A cost system kept on a card in this manner will present the facts clearly in any desired detail, for any length of time and at any period as to:

1. How much was spent.
2. How much each unit of output cost.
3. How much it should have cost.
4. What the fluctuations of expense and unit cost are.
5. What the fluctuations of efficiency are.
6. How close the actual amount spent in any time is to the appropriation.

The accuracy of such graphic records is sufficient for most practical uses and references, for they allow the interpolation of unit costs to 0.001 of a cent. If the exact total of expenditure is wanted it can be had at any time from the book records, whereas the use of books and figures exclusively lacks the comprehensiveness and visual instructive value of graphs.

TABLE II

MONTHLY EXPENSE STATEMENT

-POWER PLANT FOR MONTH OF JULY, 1915

OXX	Operation	Labor	Material	Total	Unit Cost
OXXB	Boiler room wages	$2,606.45		$2,606.45	.02488
F	Fuel	577.80	38,708.43	39,286.23	.37508
W	Water		1,235.94	1,235.94	.01179
S	Boiler room supplies		112.81	112.81	.00108
G	Engineer's wages	1,434.70		1,434.70	.01370
E	Electrical wages	1,203.68		1,203.68	.01150
L	Lubricants and waste	67.45	311.67	379.12	.00362
M	Miscellaneous supplies and expenses		2.38	24.38	.00022
A	Superintendence and administration	290.96		290.96	00278
O	Records, timekeeper's office	132.68	*2.60	130.08	.00124
X	Prod. overhead pro rata				
U	Unclassified expenses				
I	Insurance				
	Damages, liability, injury				
OXX	**Total for month**	6313.72	40390.63	46704.35	.44589
	Six months' average	$6,165.37	$36,745.48	$42,910.85	45106
MXX	**Maintenance**	**Labor**	**Material**	**Total**	**Unit Cost**
MXXB	Land	$116.95		$116.95	.00111
C	Buildings	34.00	.13	34.13	.00033
D	Dams, canals, etc.	*69.55	....	69.55	.00066
E	Boilers and auxiliaries	892.85	421.77	1,314.62	.01257
F	Gas production equipment				
G	Water wheels etc				
H	Engines, turbines, auxiliaries	494.65	*360.29	854.94	.00816
J	Sta. wir. and trans. equipment	12 82	10.25	23.07	.00022
K	Generators and exciters	194.05	24.81	173.86	.00166
L	Switchboard	11.05	13.25	24.30	.00022
M	Transformers in station	25 60		25.60	.00024
N	Station meters	22.80	104.56	127.36	.00121
P	Coal storage and hand	114.80	134.52	249.32	.00239
Q	Station piping	140.80	55.03	195.83	00187
R	Sid's, trestles and piers				
S	Tools and implements	77.85	95.32	173.17	.00166
T	Furniture and fixtures in station	58.40	173 35	231.75	.00221
U	Board and fares, maintenance men				
V	Unemployed time, maintenance men				
W	Unclassified upkeep	3.87	33.85	37.72	00036
X	Maintenance overhead charges	280.89		280.89	.00268
MXX	**Total for month**	$2,505.93	$1,427.13	$3,933.06	.03756
	Six months' average	$2,546.39	$1,824.02	$4,370.41	04593
PXX	**Production**	**Labor**	**Material**	**Total**	**Unit Cost**
PXX	**Total for month**	$8,819.65	$41,817.76	$50,637.41	48345
	Six months' average	$8,711.76	$38,569.50	$47,281.26	49699

Output	K.W.H.	B.H.P.
Total generated during month	10,471,360	
Total purchased during month	000	
Grand total	10,474,360	
Lbs. coal per K.W.H.	2,716	
Load factor	86.2% Mach.	49.9%, Peak

Clerk	Plan. Engineer	Chief Engineer	Accountant	File

Any comparison of production costs of various plants may now be made in a different light. By comparing standard costs of one plant with those of another, one gains the knowledge of how much cheaper the power can be produced in one plant than in another, due to its various physical advantages, corrections for load and output all being automatic. Again, by comparing how near the actual cost of one plant is to its standard cost, with the difference between the actual and standard costs of another plant, one has at once a measure of quality of methods and management. Thus, referring to Figures 36 and 37 the actual cost per thousand kilowatt hours of .35 cents in one plant means a worse operating efficiency than .48 cents in another plant under another load condition. Yet without such accurately predetermined standard costs, individualized for each plant and condition, no correct comparison is possible, and conclusions drawn from a mere study of accountants' figures are apt to be grossly in error.

Figure 38 reproduces a diagram of standard cost for a hydro-electric plant consisting of four 500 kw. generators. This equipment is located in a hall adjoining the turbine room of a plant whose costs are shown on the diagram of Figure 37, and, therefore, the same crew attends to both steam and hydro-electric equipment. The payroll is prorated between the outputs of both.

The cost of power is thus regarded as the result of operating methods on the one hand and given physical conditions on the other. If the cost analysis succeeds in segregating these elements and measuring each one, the most valuable knowledge will be obtained. If prices of materials, supplies and labor are known, efficiency and characteristic of equipment determined, nature of service, the character of the load and local factors would influence the expenses in a manner not difficult to determine. In a given plant all these elements remain constant until a change is made by new installation, new market prices or new field of service, etc., all of which are readily noticeable and accountable. Now, if the costs still fluctuate, the difference between the actual and the predetermined costs is due to variation of the methods of management of the plant. If these methods are studied, the best way selected, men trained and practice standardized and the costs still deviate from the predetermined standard (other conditions being constant or equated for) it means that the task is not lived up to, that is, the management fails to manage.

This method of studying costs offers, therefore, a measure of the efficiency of the plant management. If the principles and methods selected and used are right, the results can be depended upon and will necessarily be as expected and the best known method finds its expression in the predetermined cost (standard).

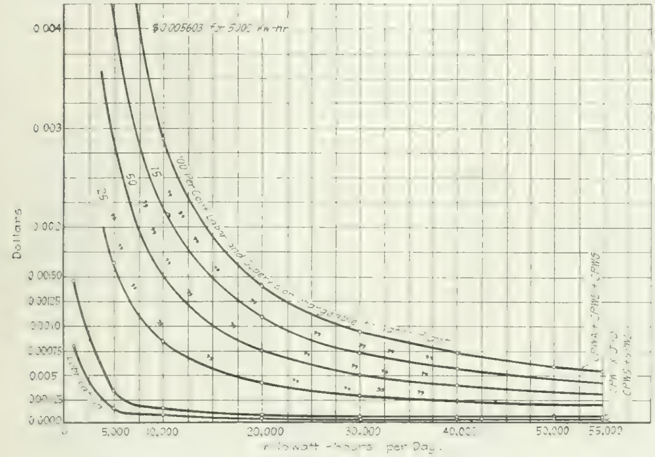


FIG. 38. STANDARD COST OF ONE KILOWATT-HOUR AT A MEDIUM SIZE HYDRO-ELECTRIC PLANT

Classification of Expenses

All expenses incurred in power-plant operation may be divided into two main groups:

1. *Productive expenses* are all those expenses that must be necessarily incurred to produce the commodity of the desired quality, in the desired quantity and to contribute to the value of the product.

2. *Non-productive expenses,* on the contrary, are such expenses that either may be eliminated altogether, or they have no bearing on quality, quantity or value of the commodity actually produced.

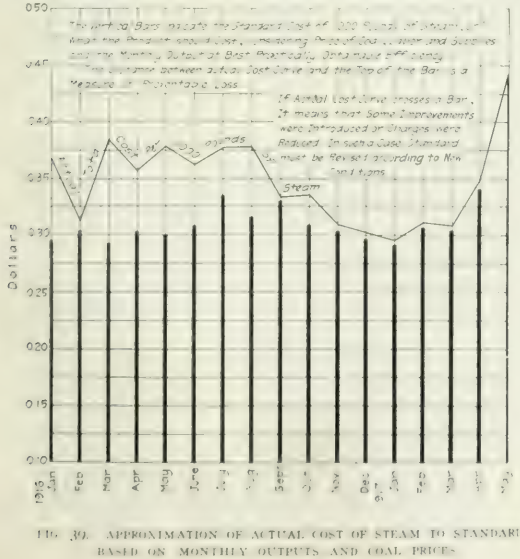


FIG. 39. APPROXIMATION OF ACTUAL COST OF STEAM TO STANDARD BASED ON MONTHLY OUTPUTS AND COAL PRICES

To this second group belong such expenses as rent, interest, depreciation, insurance, etc., *of the idle portion of the plant,* damages due to interruption of service and the like, the *pro rata* on the output of administrative business and other expenses if the plant is not operated at its safe full capacity and, in case of a complete shutdown of the plant, it comprises all the expenses incurred during the period of idleness or caused by it. Opposed to this group, the productive expenses are those incurred in the course of production. All these are further divided into four classes:

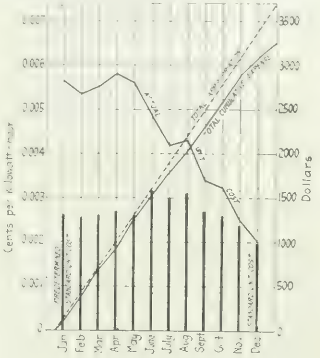


FIG. 40. YEAR'S PROGRESS IN APPROXIMATION OF STANDARD COST

A. *Administration* expenses include supervision,

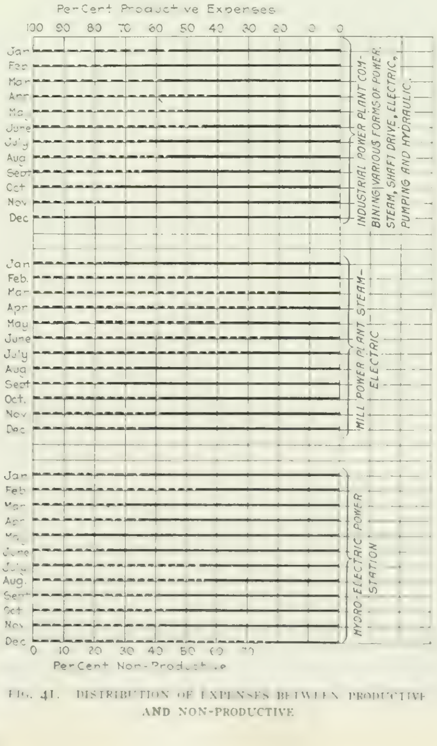


FIG. 41. DISTRIBUTION OF EXPENSES BETWEEN PRODUCTIVE AND NON-PRODUCTIVE

foremanship, business expenses, tests and experiments, rearrangements and betterments, damages and liabilities, and all overhead or fixed charges.

Ax. *Auxiliary expenses* may be regarded as a subdivision of administrative expenses and are those incurred in conducting departments which may be dispensed with and their service secured from outside. Such are the laboratory, trucking and machine shop. Separation of this kind of expenses is necessary to reach a decision whether or not the continuation of their services is desirable.

M. *Maintenance expenses* are those necessary to maintain the plant in perfect operating condition at all time, and include all labor, materials and supplies used in maintenance and repair of property and equipment, but do not cover the expense of operating upkeep.

O. *Operating expenses* are those incurred for securing all materials, supplies and labor directly and completely used up or transformed into finished product—power in one form or another.

Each one of these classes should, of course, be further subdivided into such detail and separate items as may be warranted for the purpose of making an itemized analysis of expenses, allocation and measurement of waste and derivation of the true cost of product and idle or non-productive expenses.

As has been shown before (INDUSTRIAL MANAGEMENT, February, 1918), rent and other fixed charges on the idle portion of the plant are segregated and kept, not as a part of the cost of product but as a *business loss,* and their relative magnitude serves as an incentive and guide for the efforts of the new business department in a public utility company, while in a factory power plant such a business loss on the excess power capacity may indicate either lack of work in the manufacturing department or an original overestimation of the power requirements. A remedy may be found by increasing manufacturing, by disposing of the surplus power equipment, or by selling power generated from otherwise idle equipment. The writer has had experience along such lines, and the price at which the isolated plants were able to furnish power to outside customers was but a fraction of the usual public utility rates.

Obviously, administrative expenses must be treated in the same manner. If an administrative organization, maintained at a certain expense is capable of handling a plant producing a full output, half of the output should not bear a double surcharge, for the consumers do not get any additional value from power thus overtaxed. Similarly, the expenses of maintenance remain nearly the same whether the plant is loaded to the safe full capacity or greatly underloaded. The simplest and most logical way of pro-rating these expenses to productive and non-productive groups is by a percentage of actual output to the predetermined safe full output of the plant. The kilowatt hour is a convenient unit for an electric plant; while in a factory power plant furnishing a variety of forms of power the basic form of power—steam—measured, say, in 1000 pounds or in b.h.p. renders a fair and convenient basis for determination of the extent of the utilized portion of the plant.

TABLE III

DETAILS OF OPERATING EXPENSES

ELECTRIC

CP CPX	Production Steam Plant	November, 1913			Three Months Ended Nov. 30, 1913	
		Amount	Per KWH	Amount	Amount	Per KWH
	Operation		Decrease —or increase + of average of 3 months			
CPXA	Superintendence	$177.47	+ 15		$486 00	
CPXB	Boiler room wages	1,127.70	— 22		3,447.80	
CPXD	Damages, injury & lia. ins.	106.08	— 1		320.55	
CPXE	Engine room wages	179.66	— 8		562.44	
CPXF	Fuel	3,395.44	—484		11,638.80	
CPXG	Electrical wages	120.49	— 31		453.50	
CPXJ	Insurance other than liability	5.58	— 0 3		17.28	
CPXL	Lubricants	94.85	+ 52		125.25	
CPXS	Station sup. and expenses	182.03	+ 11	Total	512.65	
CPXX	Unclassified pro. expenses	23.51	— 4	decrease	80.03	
CPX	Production overhead	118.03	+ 3	—469 3	345.11	
	Total	$5,530.84	.0035		$17,989.41	.0037
	Maintenance					
CPXM-B	Land	....			2.07	
CPXM-C	Buildings and their equipment	21.72			115 96	
CPXM-D	Dams, canals and tail races	.28			.28	
CPXM-E	Boilers and auxiliaries	98.09			398.68	
CPXM-F	Produced gas equipment	...			.06	
CPXM-G	Eater wheels, gates, gov.	....			.99	
CPXM-H	Engines, turbines and aux.	94.95			355.53	
CPXM-J	Condensers	7.27			21.38	
CPXM-K	Generators and exciters	1.60			2.26	
CPXM-L	Switchboards	1.82			60.66	
CPXM-M	Transformers in power station	216.83			220.14	
CPXM-N	Station meters	1.36			29.17	
CPXM-P	Coal storage, wgt. and equip.	.92			4.26	
CPXM-R	Ry. siding and coal trestle	11.90			12.50	
CPXM-S	Machine tools and implements	11.27			13.42	
CPXM-T	Fur. and fix. in power station	1.00			16.18	
CPXM	Production overhead	28.53			55.74	
CPXM-U	Board, carfare, maint. gang	1.53			1.53	
CPXM-V	Unemployed labor, main. gang	.	+$53		23.61	
CPXM-V	Unclassified production equip.	.			2.24	
	Total	$498.97	0003		$1,336.66	.0003
	Total production	$6,029.81	0038	$412	$19,326.07	.004
Per Cent Operation to Total Expenses			91.7			93.1
Per Cent Maintenance to Total Expenses			8.3			6.9

Steam Generated Output for November	1,569,830 KW Hrs
Labor Percentage	65 Per Cent
Daily Average Output	52,328 KW Hrs
Standard Unit Cost	33.7
Managerial Cost Efficiency	96 Per Cent

The chart of Figure 41 illustrated a few typical examples of a large proportion of the non-productive expenses incurred by power plants, partly due to a lack of work, partly to over-equipment.

Table IIIa

DETAILS OF OPERATING EXPENSES

ELECTRIC

CP CPW	Production Water Plant	November, 1913		3 Months Ended Nov. 30, 1913	
		Amount	Per KWH	Amount	Per KWH
	OPERATION				
CPWA	Superintendence	$88.71		$186.18	
CPWD	Damages, injury and liability insurance	20.28		38.69	
CPWE	Engine room wages	97.19		209.83	
CPWF	Fuel	.29		.29	
CPWG	Electrical Wages	68.96		165.77	
CPWJ	Insurance other than liability	.87		1.88	
CPWL	Lubricants	5.16		11.47	
CPWS	Station supplies and expenses	87.61		222.01	
CPWX	Unclassified production expenses	13.45		41.99	
CPW	Production overhead	15.42		60.27	
	Total	$397.94	.0004	$937.38	.0005
	Maintenance				
CPWM-B	Land	$11.14		$2.95	
CPWM-C	Buildings and their equipment	1114		39.56	
CPWMD	Dams, canals, tail races	.16		3.56	
CPWM-E	Boilers and auxiliaries	3.24		3.24	
CPWM-G	Water wheels, gates and gov	13.56		*50.34	
CPWM-H	Engines, turbines and auxiliaries	.27		.98	
CPWM-J	Condensers	4.16		9.55	
CPWM-K	Generators and exciters	3.48		3.52	
CPWM-L	Switchboards	1.04		9.17	
CPWM-M	Transmission in power station	122.96		124 50	
CPWM-N	Station meters	.78		5.54	
COPWM-P	Coal storage and freight equipment			.09	
CPWM-S	Machine tools and implements	..		.08	
CPWM-T	Furniture and fixtures in power station	....		1.88	
CPWM	Production overhead	10.22		24.04	
CPWM-U	Board, carfare, maintenance gang	.87		.87	
CPWM-V	Unemployed labor, maintenance gang			11.11	
	Total	$171.88	.0002	$190.30	0001
	Total Production	$569.82	0006	$1,127.68	0006
CPWS	Station supplies and expenses	87.61		222.01	
CPWX	Unclassified production expenses	13.45		41.99	
CPW	Production overhead	15.42		60.27	

Daily Average Output	29,926 KW Hrs.
Labor	35 Per Cen.
Standard Unit Cost	.000345
Cost Efficiency	86.3 Per Cent
Output by Water Wheels, November	897,770 KW Hrs., 35 Per Cent
Total Coal Used	1910 Ton
Total Steam Generated	24,212,299 Lbs
Average Boiler Efficiency	51.2 Per Cen

For the sake of a brief review of the use of cost data thus compiled, three monthly cost summaries are reproduced from three different power plants. Table I shows a report of a factory power plant running at a low boiler efficiency (51.2 per cent.) and greatly underloaded, over 60 per cent. of the power capacity being idle. Another peculiarity is a too low payroll due to a shortage of men, as well as a too low wage rate at which no good men can be had. Comparing the actual cost with the predetermined standard shows that the managerial efficiency is about 90 per cent., while the efficiency of the operating end is only 87.3 per cent. The thermal efficiency of the boilers was 51.2 per cent. yet the commercial economy is 71.5 per cent., since the standard thermal efficiency determined for the boiler plant was 71.5 per cent. as the best possible long average performance.

From this analysis the problem before the management shows in a concrete form: To save $20.000 per year, additional men must be employed and all should be better paid. With improved human relations better methods of firing and care of boilers should be devised to reducing coal consumption materially, and at the same time the maintenance expense which is temporarily high, due to a rundown condition of the plant, will gradually be lowered as periodic inspection and scheduled overhauling are inaugurated.

Referring now to Table II, the monthly expense statement of a railway plant, it may be fitting to state that this report was accompanied by the following note:

> The cost of production at the power plant for July, the first month of operation in the second year under the new mode of management, was 0.48345 cent per k.w.h. For the month of July one year ago the cost was 0.558 cent per k.w.h. The saving of 14 per cent. or about $85,000 on an annual basis was accomplished without physical improvement of any kind.

In other words the managerial efficiency was improved within a year from 63.5 per cent. to 89 per cent. while the operating cost efficiency for the month illustrated was 90 per cent. compared with the standard cost.

The cost record Tables III and IIIA can be studied in connection with the standard cost curves reproduced in Figures 37 and 38. In this connection it might be of interest to note that accomplishment of such high cost efficiency by the plants of this public utility company permitted a revision of their rates and resulted in a very material reduction to the consumers with correspondingly increased net revenue of the company.

(To be concluded.)

* * * *

We have not yet reached the point where we can standardize the wage rates for all classes of labor, but I may say that through the influence of the Employment Service of the Department of Labor that common labor has been brought very much nearer to a standardization than what it was when the Employment Service took hold of the problem a few months ago, and it is becoming more nearly stabilized as a result. We have not, however, as yet solved the problem of standardizing and stabilizing wages. We are simply working upon it.

We will have to be guided to a considerable extent by experience. Our experience in other lines thus far has demonstrated that it is an advantage to have a single uniform rate, notwithstanding the variations in the cost of living. A wage rate, for instance, for common labor at 35 cents an hour in a small town in the interior has a very much greater purchasing power for all of the things that go into the cost of living than 35 cents an hour in the city of New York, but if we were to standardize on the basis of the cost of living in each community there would still be an unrest, and a very serious unrest.—*Hon. W. B. Wilson, Secretary of Labor.*

Putting Round Pegs in Round Holes

Are You Using Your Employees Wisely?

by George Kingdon Parsons

In his professional work as an industrial engineer, business counsellor and executive, the author has taken advantage of the opportunity to observe critically a large number of persons in their several occupations. Furthermore, he has made a careful study of the best that is known on the subject of character analysis, and has greatly extended the success of his own efforts in bettering industrial organizations by using this knowledge in selecting persons according to their aptitudes as indicated by observed characteristics. The subject of character analysis has been conjured with by theorists and inexperienced charlatans. But many industrial executives realize that there is a definite ability and a real art in judging men. Mr. Parsons has adapted this art in solving problems of industrial and business organization.

Mr. George K. Parsons *has served in many industries and in every rank from apprentice to president. His technical education was obtained at Cornell, which conferred upon him the degree of mechanical and electrical engineer. For many years he has been in consulting and executive work in industry, and is founder of the G. K. Parsons Corporation, engineers and business counsellors, which renders counsel on industrial and business problems. In addition he is an officer, administrator and advisor in several corporations and private enterprises. Perhaps his greatest success lies in his ability to understand men.*

HOW do you determine what kind of work a man can best do? What are your methods, not alone in hiring but in classifying employees?

Of the people of your acquaintanceship, how many do you feel have really found themselves—are in the work for which they are best adapted and are really successful? Talking with other people, and judging their success in life, one cannot fail to feel they lack deep interest in their work and that dissatisfaction and discouragement are very general. Now and then we meet a person who is happy and joyous in his work, who is a success in every way, but he is so rare that it seems almost safe to say that he does not represent more than five per cent. of the population. Observation leads us to believe that the great majority of persons have secured their present positions through circumstances rather than aptitude. The history of almost every man reveals a stumbling, groping search for his own kind of work.

We have been in the habit of placing great value upon previous experience when hiring and selecting employees. Why have we disregarded natural aptitude? Probably it is because it is difficult to determine from observed characteristics. But is it not fair to believe that fitness for a given kind of work should be graded in an ascending scale thus (1), experience; (2), aptitude; (3), aptitude and experience.

The method adopted by practically every employer in determining the aptitude of employees is based upon their experience, yet this experience has usually been gained in a line to which the worker was poorly adapted. Therefore, the value of such records is minimized, and we cannot but feel how unwise it is to hire and locate employees solely on the strength of their past experience. Just because a man may have done a certain kind of work for a certain number of years in a fairly satisfactory manner is no indication that it is the best line for him. Very often he is not adapted to his work.

Do You Determine Requirements for Jobs?

Have you ever definitely set down the requirements that a man should have for each particular job in your business? Have you ever analyzed the mental and physical characteristics that a man must possess in order to fulfill these requirements?

Would you not know a Ford when you saw one? There are hundreds of kinds of automobiles, yet any one can recognize a Ford from almost any angle and regardless of its color or such special features as may have been added. You recognize it although it is camouflaged with a home-made truck body, or even though it has no body at all. More than that, you know exactly the kind of work a Ford can do. In other words, you know the work to which a Ford, as compared with other cars, is best adapted. If you were trying to purchase heavy trucking equipment you would not buy a Ford. Why? Because you know it is not adapted to this work, and yet it is marvelous how much a "flivver" can carry and also how much it can drag behind in a trailer. The reports that you might get from users of Fords as trucks would give them a very good account, yet you know they are not the kind of machine you want for heavy hauling.

If you have a machine shop, you know the different classes of lathes. Each kind of lathe is adapted to its particular kind of work, and when you buy a lathe you buy one to suit particular requirements. You study these in detail, analyzing carefully the kind of work you have to do, and then pick the kind of machine which is best fitted to do that work.

Do you use half as much discrimination in utilizing labor? There is a greater difference between men than between classes of machines, vastly greater, yet are you as keen about selecting and utilizing men as you are about picking out automobiles or machine tools? Very few employers can answer "Yes" to this question.

How do you recognize a Ford from any other car? Is it not by the little earmarks, such as the radiator cap, the front view of the radiator, the rear axle, or what not, that sticks in your mind? And yet, do you recognize the earmarks of men? Even though you know that men are not so much alike as standard manufactured products, yet do you recognize their characteristics and possibilities from their distinguishing marks without being deceived or confused by appearances or representations?

Some Things You Would and Would Not Do

You would not hire a reticent "high-brow" as salesman, or a professional "crook" as cashier. You would not use a man who was deficient in ordinary mathematics or calculation as an auditor. An auditor would not be a very efficient lathe hand; you would rather have a dexterous, observing fellow. You would put a careful, cautious man in charge of your engine room.

An employer recently complained that he had repeatedly met with failure in getting an operator for a tabulating machine because of the monotony of the work. When the writer asked him whether he had determined in advance whether the person could endure monotony or not, he stated that he had not, but that his method was simply to hire one man after another, educating each at an expense of from $100 to $250, keeping him until he discovered that he was no longer able to keep his interest in routine work, and left. How much cheaper it would have been to have these employees selected by an expert in studying men, and how much discouragement would have been spared both employer and employees.

Though a man may have two good eyes, he may not be an observer; though he may have two good ears, he may not be attentive. Some men analyze, some reason, some remember, some obey, some have initiative, some jump at conclusions. Why not know your man before he costs you too much? Why not capitalize his characteristics? The employer of labor can never attain the highest possible results until every employee is doing his best. This is not possible unless each employee is in the work he is best adapted to and where he is the best satisfied. It is the function of the executive to see that every bit of material and equipment, and every individual as well, are used efficiently; that the round pegs are put in the round holes. These changes must be made slowly, but you certainly ought to catalog each man as carefully as you do your machinery, and hire each new man by these accurate methods. Remember, we do not say that experience is of no value, but experience is of far less value than aptitude coupled with experience. If you hire a man on his recorded experience, you are using a poor indicator of his real ability, unless you know that he has found himself.

The Value of Aptitude

It is a common experience that a worker put on unfamiliar work will often, in a very short time, become far more proficient than others who have been doing this particular work all their lives. You have seen this occur many times. The writer's industrial experience has been filled with observations of this kind. And if it occasionally happens that the shifting of men brings such marvellous results, why not do this shifting scientifically? Why not use men as wisely as you buy and use machines? The importance of this is more forcibly shown when we consider the ordinary business in which the annual payroll amounts to the value of the plant and equipment. With money at six per cent., the payroll amounts to 16⅔ times the value of the plant as a capitalized proposition, or looking at it another way, the amount spent on the payroll would pay the interest on the money which would furnish a plant 16 times greater than the one you have. Looking at it still another way, you spend only six per cent. as much for your plant as you do for your payroll annually, and yet you undoubtedly devote a greater amount of expert attention to the details of your plant and equipment than to your individual men.

Anyone can see the difference between a big burly man and a frail girl. A great many people can tell the difference between a strong and a weak face, but the keen observer can go much further and from careful, detailed observation of facial characteristics, mental reactions and a study of the body and its bearing, tell very accurately the main and minor features of mind and will which go to make up the personality of an individual. To the professional observer with a trained analytic mind, people's abilities are as readily identified and classified as you classify and segregate the various capabilities of automobiles and machines that you see.

A Few Occurrences

A few years ago a plant required a sales engineer for an emergency and the writer picked a man from the superintendent's office. This man's experience had started in the shop as messenger boy, taking him through the various workman, clerical and foremanship steps until he had finally become assistant superintendent. He was handicapped by a brogue and had no selling experience. Though he had all these handicaps and lack of experience, he successfully closed the two important contracts which had caused the emergency and later became sales engineer.

Another plant needed a superintendent and the writer made a careful study of available material, finally locating a young man who was working in the laboratory, who later substantiated the judgment of the writer and became a great success as a superintendent and plant manager.

If you have had children, you have had a similar problem brought very forcibly to your attention. One of your boys liked electricity and thought he would become an electrical engineeer. His brother was an omniverous reader of history and his mother had fond hopes of seeing him become a college professor. Many a long and serious discussion you had regarding their future, wondering whether the youthful tastes were true indicators. Then you saw them groping around, studying this and that, getting different positions. Perhaps the would-be electrician finally made a success as a superintendent of a cotton mill, while the other became a salesman.

Have You the Maximum Training for Your Own Work?

If you yourself throughout your whole life had known positively that you were to occupy your present position, would you not now be far more capable? You would not have wasted your time trying this job and that at work which you positively know would not lead you toward your goal. Unless you are a most fortunate individual, you can look back on your life and see many years practically wasted in work which benefited you little and contributed very little to your real success. If someone had analyzed you or your children and had told you the controlling capabilities and how to develop them, you would have been spared a great deal of lost time and discouragement.

You know many moderately successful men who have risen in spite of early groping, yet the ones who are most successful are those who made each choice most fortunately. Here and there are successful men who have risen by sheer energy and predilection. It is the few who, by predilection, circumstance or accident have found themselves early in life that we look upon as being the most successful. The wisest employer sees that each employee is analyzed and given an opportunity to become as successful as he can.

Rules for Computing Gage Tolerances

Three Simple Rules Show How to Compute the Overall Length, Mean Length and Mean Depth of Finish

By D. Douglas Demarest

The manufacture of munitions has shown the extreme importance of gages. But not always have the fundamental principles of gage design been followed, particularly in determining the tolerances for limit gages. This article is helpful as it lays down simple rules for [illegible]

Mr. M. Douglas Demarest *after completing his technical education took the graduate student apprenticeship course of the Westinghouse Electric & Manufacturing Company, completing that in 1915. He is now production and industrial engineer with the New England Westinghouse Company at Springfield, Mass.*

IN considering gages it must be constantly borne in mind that they are a direct opposite of the cutting tool. The tool removes stock and leaves a surface. The gages perform no work themselves, but check work already done.

The tool does only one thing; the gages must oversee everything and overlook nothing.

As one weak link may break a long chain, so in manufacturing a complicated, interchangeable part, any operation not completely controlled by its gages may utterly disrupt production or cause interminable delay in getting started.

The following are some of the more frequent troubles experienced with gages:

1. Each individual gage must tell a true story. If it is to be used by inexperienced girl inspectors it must also be as near fool-proof as possible. Many gages give a false reading by attempting to cover too many points, particularly on the "NO GO" end.

A simple example is a gage for a square hole. See Figure 1. A common style of gage for this hole would be similar to gage A, a double-ended plug, one end having the minimum and the other the maximum size of the hole. A square hole within these limits will accept the "go" and refuse the "no go" end, and so also may an oblong hole, a diamond shaped hole, or even, in an extreme case, a round hole, which is absurd.

Much better gages for this purpose are a double ended width gage and a single ended square plug, such as gages B and C. The square plug has the minimum size and, if it enters, the hole is then at least large enough. The thin width gage has on one end the maximum distance between opposite sides of the square. If this will not enter, then the hole is not too large in any one dimension, and consequently is acceptable. The "go" end of the width gage is used when the square plug will not enter, and indicates which dimensions are below size, or whether the plug is hanging up on corners, etc.

The "No Go" part of a gage should check only one dimension. When it attempts to check more than one it is evident that should any one of the several dimensions be correct, the part would refuse the gage the same as though all the dimensions were within the established limits.

2. The gages at each operation should tell the whole story. Under certain conditions parts may meet all the gages assigned and yet be troublesome at a later point or on the assembling floor. If each gage tells a true tale and the tolerances are properly computed, then a careful investigation will usually show that at least one operation is not completely controlled by its gages.

A case of this kind is a part similar to Figure 2, having several dimensions, each of which is given definite limits. When these dimensions are gaged separately it is possible for every one of them to be within the prescribed limits, and yet for the part to give trouble at assembling. In this particular case a combination gage similar to the part with which this must assemble will assure that a part meeting this combination gage and having each of its dimensions within the given tolerances will be satisfactory.

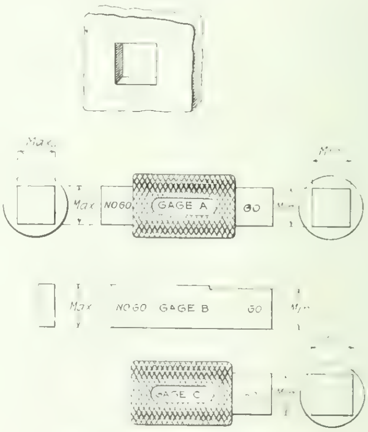


FIG. 1 GAGE FOR SQUARE HOLE

Examples of incomplete gaging are innumerable. Bar stock cut to proper length for machining will not clean up unless the ends are square, yet how much labor and material has been lost because the cutting-off department used only the length gage and did not also use a square.

In drilling holes through material of any considerable thickness, both ends of the holes must be checked, for though the holes may start properly they are liable to be out of location when they get through to the other side. If both ends are gaged the operator will learn to control the cut or get another job.

Errors of this nature are perhaps the most persistent and vexatious experienced in manufacturing interchangeable parts. They are errors of omission rather than of commission, and therefore extremely difficult to locate and overcome.

3. All of the points gaged at any one operation

must lie within the control of that operation. Can you imagine anything more discouraging to a workman than to adjust his machine painstakingly, complete a tray of work, and then find that a large percentage of the pieces must be scrapped? To have one piece perfect and the next 'way beyond the gage limits, both off the same machine and at the same cutting?

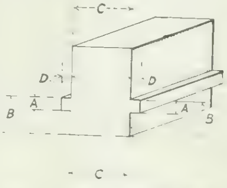


FIG. 2 EXAMPLE OF GAGE WITH [illegible]

In Figure 3 is shown an example of this error. Here is a flat piece with a recess cut into the top. In making this cut the part would usually rest on its bottom surface, yet the simplest and perhaps the most likely gage would measure from the top surface. Any variation in the thickness of the piece would endanger its meeting this depth gage, although the thickness is entirely beyond the control of the last operator. If the machine is adjusted to cut properly on a part that is near the minimum thickness and the next part is up to the maximum, the cut will be much deeper and possibly beyond the limit of the gage.

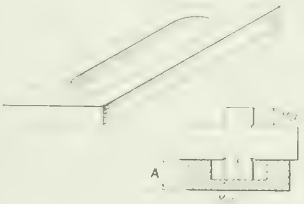


FIG. 3 EXAMPLE OF IMPERFECT GAGE CONSTRUCTION

One peculiar danger in this condition lies in the fact that with great care a moderate production may be maintained without serious loss. In the example shown in Figure 3, the workman who establishes the thickness and the one who makes the recess cut may, by close coöperation, arrange their work so that the result will come within the limits of the gage. When, however, production increases, and especially when a night shift is started, this close coöperation is lost. The width now varies the full limit of the gage, and the operators cutting the recess begin to lose time and patience, while production becomes seriously impaired.

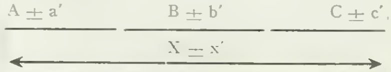
The worker is unjustly penalized and production is on an uncertain footing when one operation is dependent for its success on the accuracy of another operation not performed at the same time or under the same control.

4. The operator should be allowed the full limits of his gages. In munition works the limits on the finished parts are specified and are not within the control of the manufacturer. The operations and equipment must be laid out to meet these established conditions. Unless the manufacturer appreciates that every cut will vary independently of every other cut, and allows for this variation, he may be compelled to resort to the subterfuge of "preferred tolerances." In other words, give an operator a gage with 0.005-inch tolerance and tell him to "work to the high side." This is an absurdity, nullifying at once the object and purpose of limit gages. Provided the limits set by the Government are within reason, it is nearly always possible through careful study to give every operation definite workable tolerances.

In a way the computing of tolerances is a special branch of mathematics, which, for lack of a better name, might be termed "the study of variables within limits." It is controlled by a few simple rules that are almost self-evident, though apparently often disregarded. Some of these rules may be given as follows:

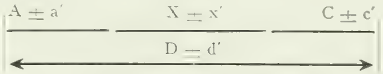
RULES FOR TOLERANCES

Rule 1. Any dimension comprising two or more dimensions, each of which may vary within certain definite limits, will be subject to a possible variation equal to the sum of the variations of all the component dimensions.



Maximum overall length $X + x' = A + a' + B + b' + C + c'$
Minimum overall length $= X - x' = A - a' + B - b' + C - c'$
Possible variation or tolerance .... $= 2x' = 2a' + 2b' + 2c'$
Mean overall length $= X = A + B + C$
½ maximum + minimum.

Rule 2. When an overall dimension and all but one of the component dimensions are assigned definite limits, the possible variation of the remaining component is equal to the sum of the tolerances of the other components plus the tolerance of the overall dimension.

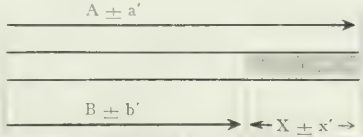


Maximum length of remaining component .. $= X + x' = (D + d') - (A - a') - (C - c')$
Minimum length of remaining component ... $= X - x' = (D - d') - (A + a') - (C + c')$
Removing parenthesis, first..... $= X + x' = D + d' - A + a' - C + c'$
Removing parenthesis, second... $= X - x' = D - d' - A - a' - C - c'$
Possible variation or tolerance .... $= 2x' = 2d' + 2a' + 2c'$
Mean length $=$ ½ (maximum + minimum).... $= X = D - A - C$

A practical application of these two rules is that tolerances should never be given to all the dimensions forming a closed circle unless the tolerance on some one dimension is equal to the sum of the tolerances on all the other dimensions.

Another application is that when a dimension is obtained by several independent cuts, the limits given to these cuts must be such that the sum of their tolerances is equal to or less than the allowable tolerance on the resultant dimension.

Rule 3. The amount of stock left by a roughing cut for removal by a finishing cut is never a definite amount, but a variable with a possible range equal to the sum of the tolerances of the rough and the finish cuts.



Maximum amount left for finish cut $= X + x' = (A + a') - (B - b')$
Minimum amount left for finish cut $= X - x' = (A - a') - (B + b')$
Removing parenthesis, first .... $= X + x' = A + a' - B + b'$
Removing parenthesis, second..... $= X - x' = A - a' - B - b'$
Difference between maximum and minimum .... $2x' = 2a' + 2b'$
Mean depth of finish cut, ½ (maximum + minimum) .... $= X = A - B$

It is so usual to say "leave on 0.015 inch for a finish cut" that many engineers overlook the fact that the amount removed by this finish cut will more likely vary from .005 to .025 inch. This is an especially serious error when some other point is related to the rough surface, and then, when the finish cut is made is assumed to bear the same relation to the finished surface.

Possible modifications of these rules are legion, yet practically all gaging problems can be solved by the application of these three. These in turn are all based on one great principle, namely, "whenever a dimension is determined by two or more elements, it is subject to a variation equal to the sum of the variations of all the elements concerned."

The importance of gaging has long been recognized in this country. With the war has come the need of not only making duplicate parts, but of making them in accordance with prescribed limits and specifications. The experiences of the last few years have brought home to most manufacturers of machine-shop products a realization of the difficulties attendant upon analyzing these requirements; establishing the locating points and sequence of operations; and designing gages to control in the actual work the methods determined in the drafting and engineering departments.

Only by completely controlling each operation through the correct use of proper gages can manufacturing difficulties be localized and the full talent of the organization employed to overcome them and facilitate production to the fullest extent.

* * * *

Need for Organized Trucking

Idle Time of Equipment is the Great Obstacle to Economical Handling and Transportation

By W. C. Nisbet

This article is an appeal to consolidate, plan and schedule our systems of local trucking for the purpose of eliminating the tremendous wastes that every one sees about us—witness the empty, partially empty and idle trucks in the streets of any city. The author advocates the use of large automobile trucks with removable bodies, assembling crates and unit packages.

Mr. W. C. Nisbet *after graduating from the Sheffield Scientific School was employed for ten years until 1912 by the Pennsylvania lines West of Pittsburgh doing construction and maintenance engineering and betterment work. From 1912 until the present he has been connected with the Emerson Company, putting industrial engineering work in the textile mills, iron and steel plants, quarries, mines and industrial plants. For the past year he has been on the staff of the traffic vice-president of one of the trunk line railways studying the possibility of using automobile trucks.*

When the railways, constituting one set of carriers in this country, asked for a raise in rates, a nation wide campaign opposed it. Another set of carriers, the truckmen, have made raises which per ton amount to twice as much, and hardly a murmur is heard.

In the latter case the action is more gradual and scattering, besides, very frequently the manufacturer or merchant is his own truckman and the rates referred to are his own mounting costs of fuel, feed, repairs and labor.

Why are trucking expenses so high and are the current increases in such expenses preventable, are questions of great importance to American business.

It has been estimated that the national trucking bill per year is as great as the national freight bill, a statement which does not appear so far out of reason when we consider that many products are trucked to, and later from the railway station to the jobbers' warehouse, then to the retailer's store and finally to the consumer's house, totalling four handlings by truck to one by rail.

It would be easy to cite hundreds of instances where a shipment between two nearby cities taking a freight rate of $0.20 per hundredweight had four handlings by truck at an expense of $0.10 per hundredweight for each, or $0.40 per hundredweight for trucking expense.

Fortunately for us, on the other hand, we have many instances where, as in the case of coal, there is but one truck movement from the mine to the consumer.

Trucking expenses are high because, particularly in the large cities, we are trucking immense quantities of freight either without any system at all or with antiquated systems not worthy to be dignified with that title.

Our Lack of Distributing Organization

If we could guess the thoughts of an intelligent foreigner, let us say a visiting Japanese, in this country to study American distributing systems, we could hardly expect him to admire our supposed genius for organization, standardization and specialization when he views the idle drays and trucks standing at our large docks and freight stations on the North and East Rivers in New York, the Delaware River in Philadelphia, Water Street, Pittsburgh and other similar shipping and receiving stations in the large cities.

These long lines of waiting drays and trucks constitue an alarming menace to distributing economy.

An analysis of the vehicles at a freight terminal shows many one horse drays bringing small cases for shipment and returning empty, thereby using practically the wagon space at the terminal and the same man power as the large capacity trucks.

Wagon congestion increases more rapidly than the increase in the number of vehicles, this is due to blockades and complications at platform. Costs of trucking also increase as congestion leads to delay, and delay to more congestion.

As to the automobile trucks, they, of course, constitute if properly assigned and directed an economical system of city freight distribution but unfortunately as even the truck manufacturers declare there is much to be desired in the direction of more complete utilization of the equipment in use.

The criticism frequently made as to Government trucks, that they are usually seen going somewhere in a great hurry, empty, applies in some measure to commercial trucks as well.

As long as trucking in the large cities remains as unorganized as at present with private concerns doing their own trucking, even if their vehicles are idle or empty one-third to one-half of their time, there must be great economic waste.

We may expect the final solution of the city delivery problem to take the form of extensive trucking organizations which have cheapened the cost to individual concerns to an extent which made them glad to give up their own freight hauling outfit.

ADVANTAGES OF CONSOLIDATED TRUCKING

Our low freight rates would manifestly be impossible if a multitude of individuals were engaged in the business of transporting freight say from New York to Chicago. It is equally clear that if the draying business in each large city was consolidated and the most modern methods of selection, assignment and use of vehicles were adopted, the cost could be materially lowered. Especially so if the concern suggested took the advanced view of merchandising as exemplified by Henry Ford and his well known product wherein the cost is not placed at the highest point the trade will pay, but rather at the lowest point of profitable operation. The immense growth of the business resulting, gives a rapidity of increase in profits very different from the slow progress of the opposite method.

Let us consider an organization evolved to handle the trucking business of a large city. It would use a variety of vehicles selected after study and investigation by that part of its staff assigned to such duties, which would include high capacity electric trucks for short hauls and frequent stops in selected parts of the city, the high speed lower capacity gasoline trucks for longer trips or hilly districts, light electric and light gas cars each for their selected tasks, the horse drawn dray also still has a field in the most congested districts or where bad roads or long stops are impossible to avoid.

Freight would be consolidated at trucking depots following collection by specified trucks over prescribed routes and then and there placed in removable bodies which after loading would be lowered to empty chasses and dispatched at favorable and predetermined hours to freight houses and docks. There, hoisting equipment would raise the body, after which the chassis would back under another removable body destined to the trucking depot for a return trip. There the large truck body would be quickly raised, releasing the chassis again and the contents which might have been made up of smaller crates, or unit packages on rollers each containing a collection of boxes for some given firm, would be redistributed to waiting suspended bodies, marked for delivery to a certain part of the city. The whole process being planned and scheduled and arranged so as to prevent *idle time of equipment* which is always the obstacle to economical trucking.

Each driver would have a certain route which would be so arranged as to require a certain scheduled time depending on distance, number of stops, character of freight, etc., all determined upon after careful study by the company's staff. He would receive a fixed weekly pay plus a bonus for making the schedule, to be further affected by the up-keep and gasoline or current consumption of the vehicle assigned to him.

USE OF THE NIGHT HOURS

The consolidating of freight at trucking depots and at freight terminals should be done at night as also should be the hauling between these points, thus allowing the most complete use of the equipment and thereby taking in full the advantage of trucks over animals in the matter of freedom from rest periods.

Its own repair shops would do all repair work for this trucking concern with regular schedule for overhauling the trucks one after another. Repair methods, times and costs could then be standardized and compared.

Careful records would soon show the most economical and satisfactory models and designs of vehicles, tires and supplies which could be purchased in volume at minimum prices.

Drivers could be selected with care, supervised effectively, and given steady and well-paid employment with the further attraction of pension and insurance features.

At terminals and trucking depots such freight handling machinery as staff studies find are economical could be installed, including chutes, cranes, belt conveyors, electric trucks, etc.

Wherever level streets, traffic conditions and the requirements of customers allow the economy of trailers could be taken advantage of. As an illustration, suppose a loaded chassis couples to a loaded trailer, draws the latter to a customer's warehouse, leaves it for unloading and goes elsewhere with the loaded chassis, later picking up the trailer reloaded with outgoing freight for a return trip. This can be done readily.

PRESENT SITUATION ONE OF WASTE

Compared with the foregoing ideal the present situation may be not untruthfully described as a composite picture of duplication, lack of coöperation, wrongly used effort and waste in general. Dozens of huge trucks come to freight houses every day either empty or with loads of but a fraction of their capacity and depart in the same condition. Too often to even excite comment two trucks from concerns side by side come to freight houses, each loaded with a few pounds and return but partly loaded.

Trucks costing their users $20 to $30 per day stand idle while being loaded and unloaded when demountable bodies in coöperative service would save much time now lost.

How few trucks are used for over 10 hours per day when a longer period of daily service would cut down the investment expense!

The present system whereby truck owners operate two or three trucks results in congestion in repair shops at certain times, excessive time out of service per truck, untrained drivers, too large stocks of repair parts, the purchase of ill-adapted models and makes.

Few truckmen know their real costs of operation or maintenance and often charge so much for their irregular service that commercial firms and manufacturers frequently continue their horse-drawn equipment basing their ideas of motor costs on the high charges of motor trucking concerns.

Lack of proper supervision allows irresponsible drivers to loaf while away on trips, or to leave engines running unnecessarily.

During a single day it frequently happens that each of a half dozen large trucks representing different trucking companies takes a small load to some neighborhood distant from the freight terminal, whereas under coöperative control a single loaded vehicle properly dispatched would fill the need completely.

APPLY PRINCIPLE OF THE UNIT PACKAGE

The principle of unit packages should be used much more extensively than it is, and could well be under the conditions recommended. This proposal means that a concern shipping daily a miscellaneous collection of boxes, kegs and containers of various sizes would place all these in a crate on wheels which on the arrival of the truck is rolled on with a minimum of delay and later is unloaded as quickly.

Consider the reduction in street traffic which would be effected by the consolidation of the trucking business from the present congestion when half or more of the vehicles are empty, to the possible goal wherein 75 per cent of them are fully loaded. This in turn would facilitate traffic remaining giving further advantages.

Certainly there is a great demand for such an improvement at present with freight congestion existing at terminals a good part of the year, with chauffeurs in great demand for war trucks, mechanics needed for munitions and ship manufacturing, horses scarce and high and in demand for cavalry and artillery.

It may be that war conditions will force the issue and government activities will speed the day when such consolidation may come. Some studies have been made by semi-governmental bodies but little definite action has been taken by any others as yet.

Consolidate Trucking

Here is a fertile field awaiting the vision and force of men of genius, or perhaps a man of genius, for as soon as one city puts this plan into successful practice imitation will surely be rapid for the need is great.

In every large city there are trucking concerns of considerable size which might serve as a nucleus for consolidations. To be sure, each of these is now perfectly willing to do all the business in the city, but they lack either the gift, vision, force or capital to effect the combination.

Another important issue in this country, on which present trucking methods have a bearing, is the acute shortage of labor which may be expected to continue indefinitely after the war. There is undeniably a widespread labor shortage at present and even with the safe return of all our soldiers and sailors under arms, the starting up of the tremendous construction works now postponed will continue the shortage of man power.

It is clearly evident that a definite campaign to do as much work by machinery as possible, and by as large machines as can be used economically, should be carried on continuously. In the trucking business there are a multitude of light single drays and similar motor vehicles each requiring a driver. In a consolidated service using as few drivers as possible and large capacity trucks many drivers would be released.

Reasons for Railway Coöperation

To accomplish the recommended combination of the many existing trucking services the railways should be enlisted and the consolidation built around them to give a complete service from the store or factory door to freight house or dock and return. The reasons why it is essential that the railways share in the movement are:

1. Because the receipt and delivery of freight at stations, if extended to store and factory door, would enable the railways to spread out the task over the whole working day and even the night, relieve freight house congestion and at the same time give vastly improved service to the users of trucking service.

2. Further, the railways already have in the large cities sub-stations for the receipt and delivery of freight which would provide distributing points for the surrounding district and allow a combination of carload and motor truck to the extent desirable and economical. They already have a box car service from main terminal to sub-terminal and return, which might be extended or restricted as economy to all concerned would dictate, provided this was combined with the trucking service.

3. The third reason for combining the railway with the city delivery service is that the use of removable bodies for the large trucks makes it essential to provide freight station space for hoisting and suspending these bodies while unloading, awaiting load and loading, and this can best be done if one organization handles the whole matter. Freight station space is also needed for assembling freight on platforms prior to loading on trucks.

4. The trucking depots could segregate units going to certain cities, place them in crates on rollers and after taking these from the removable body at arrival at the freight house, they could readily be rolled direct to the proper car.

5. The present development of highway motor transport wherein motor truck service between nearby cities is being started should be extended in co-öperation and not in competition with the railways, and as a part of the consolidated city trucking service.

Suit Vehicle and Means to the End

Wherever it is really more economical to move a shipment by motor truck the entire distance from a store or factory to another place of business in another city the goods should go that way in the proper vehicle with the proper supervision.

On the other hand in deciding as to the real economy all the basic factors should be taken into consideration and the decision be broad and general with the ultimate in view rather than based on a few cents of immediate gain. For example, the motor transport offers an apparent economy in some cases, but it pays no maintenance of way expense beyond a moderate annual license fee and public agencies have to keep up the roads.

Again, the truck operators have so far been free from the necessity of providing expensive terminals. It is evident that the existing steam terminals are a public necessity and their cost must be borne by the public so that it appears finally that whatever is decided upon as the proper course should be based on the interests of the public. This would provide that the railways as an existing agency should be fully utilized but be supplemented by a consolidated trucking service for city and suburban use to be extended to interurban districts.

* * * *

William Kent

Mr. William Kent of Montclair, N. J., an eminent engineer, technical author and educator died at his summer home at Gananoque, Ontario on September 18. In his death, the mechanical engineers have lost one of the foremost members of their profession and one of the most widely known supporters of the A. S. M. E.

Mr. Kent was born in Philadelphia, March 5, 1851 and was educated at the Stevens Institute of Technology, from which he was graduated in 1876. From 1877 to 1879 he was editor of the *American Manufacturer and Iron World* of Pittsburgh. From the latter date until 1890 he held positions as mechanical engineer and superintendent in several industrial plants including iron and steel works, steam boiler shops, etc.

From 1890 to the time of his death he practiced as a consulting engineer, lectured on engineering subjects and for five years, from 1903 to 1908, was dean of the L. C. Smith College of Applied Science of Syracuse University. Mention has been made of an early editorial connection. At two other times he was directly connected with technical journalism, having been associate editor of *Engineering News* from 1895 to 1903 and editor of *Industrial Engineering* from 1910 to 1914.

Few men have contributed as much to engineering literature as Mr. Kent. The *Transactions of the American Society of Mechanical Engineers* hold 13 papers contributed by him. But as an author, Mr. Kent will be longest and best remembered for his "Mechanical Engineers' Pocket Book."

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Why Do Valuable Men Leave?

By Russell Waldo

WHY do employers allow men who have been in their services for years to leave? It surely is not because the men are not worth the increase in wages asked for. They are worth, usually, what they want. Every year adds to an employee's worth providing he has been observing the working of the plant and has studied at all. Surely he is worth more than a man who comes in from the outside.

It is beyond my ability to understand how an organization which considers itself progressive can expect to hold that rank and continue to allow their older men to leave for a matter of wages, for these men have learned the employers' special needs. A worker who has been in the service for a year, if he has been doing even the least to make himself a better employee, is oftentimes worth more than what he asks for. After the boss allows him to go it may be necessary to pay even a higher rate than he asked for to keep the place filled.

Occasionally an employee asks for a better job so that he can earn more money. This is a common occurrence, and it is almost as common to see the request refused. After the man has been turned away from the job he will become dissatisfied and will often leave the company's service.

WHY FIVE MEN LEFT

I have seen five men leave one firm because one man was not given an opportunity. These men quit because they felt the other man was worth the better job and if he could not be promoted to it they felt that they all would be treated in the same way, and so gradually left the organization. Their leaving covered a period of four months, yet it was the result of the failure to promote the first man.

In this case the man who asked for the promotion wanted a place that was open, and a man was finally brought in from the outside to fill the place he asked for.

I have seen many cases where men were allowed to leave because the boss would not pay what they were worth, and then the company was forced to pay a higher price for men who failed, and then a higher price still for men who just managed to hold the jobs. It would have been far more profitable to have held the first men and given them a higher rate.

THE OLD EMPLOYEE IS AN ASSET

An old employee understands the organization, knows every other employee, knows what the boss expects, appreciates the fine points of the work, and is worth more than a new man because of his familiarity with the surroundings. There are certain things which every man must know before he is worth his money, regardless of what kind of an education he has. A college professor might gain that knowledge in a day, but the average man will need about two weeks in doing the same thing.

Allowing a good man to leave causes a certain amount of dissatisfaction among the remaining force. It is useless to try and prevent it. If a man leaves by his own request, this can not be averted. If a man is discharged this may happen although it is not so common. Some forms and causes of unrest are hard to prevent although this form can be, and the employer deserves nothing except to pay dearly for it. He butters his own bread and it is no more than fair that he should eat it.

When the firm grants an asked for promotion and the rate which the man requests, the management has held a man who may make a most valuable employer. A sense of pride has been created among the workers, because one of their number who was deserving has been promoted. It will cause them to study and prepare themselves that they may ask for something better, so that they may make valuable employees for the firm.

Paying a man what he is worth and giving him a chance to do something worth while for the organization whenever there is an opportunity is one way, and a sure way, of making an efficient organization and a contented one. It cannot be disregarded by the progressive, thinking employer, especially in these present times and in the times that are coming. It must be done if one expects to hold up interest among his workers and offer an incentive for good work.

The Boy in Industry—A British Effort to Protect Him

By Robert R. Hyde

Director, Boys' Welfare Association

IN one of his charming short stories Sir Rabindranath Tagore writes of the fourteen year old boy thus:

> In this world of human affairs there is no worse nuisance than a boy at the age of fourteen. He is neither ornamental nor useful. It is impossible to shower affection upon him as on a little boy; and he is always getting in the way. If he talks with a childish lisp he is called a baby, and if he answers in a grown up way he is called impertinent. In fact any talk at all from him is resented. Then he is at the unattractive, growing age. He grows out of his clothes with indecent haste; his voice grows hoarse and breaks and quavers; his face grows suddenly angular and unsightly. It is easy to excuse the shortcomings of early childhood, but it is hard to tolerate even unavoidable lapses in a boy of fourteen. The lad himself becomes painfully self-conscious. When he talks with elderly people he is either unduly forward, or else so unduly shy that he appears ashamed of his very existence.
>
> Yet it is at this very age when in his heart of hearts a young lad most craves for recognition and love; and he becomes the devoted slave of any who shows him consideration. But none dare openly love him, for that would be regarded as undue indulgence, and therefore bad for the boy. So what with scolding and chiding he becomes very much like a stray dog that has lost his master.

This of the boy is eternally true. He craves for leadership, for heroism and romance. In some directions he finds it, as for example in the history of the

Army and Navy, but unfortunately, at any rate during the last hundred years' growth of the present industrial system, he has never been allowed to discover either romance in industry or dignity in labor.

Neglect of the Boy in Industry

This negligence on the part of his elders is as wrong as it is shortsighted. The boy with all his strange desires and imaginations remains a boy in spite of the efforts to render him, in his work, a soulless automaton.

The boy and his potentialities too long have been overlooked; he has been regarded as a "hand," as a necessary adjunct to the producing machine, and he is frequently broken in consequence. Left alone he becomes self-centered and selfish, and the resultant individualism finds later expression in class war, and internecine struggle between the various sections of which the industrial community is composed.

The war, however, has served to stimulate the conscience of the community in regard to its responsibility to the juvenile worker. The elders are beginning to realize that one result of the war will be to destroy a generation, and the gap between the man of forty-five and the young man who just manages to escape the horrors of war must be filled up by the adolescent.

In the early days of the war when the demand for munitions was hurried and incessant, some hundreds of thousands of young boys rushed into munition factories cheerfully offering their young shoulders for the purpose of bearing a share of the burden of war. Hours of labor were long, and the possibility of earning abnormal wages tempted them to overtax their strength. Their parents were away—the father training or fighting, the mother working away from home. It was not to be wondered at that juvenile crime increased and disregard for the seriousness of life appeared.

Governmental Efforts

To meet the danger, many efforts were made by various state departments. The Home Office, the Ministry of Munitions, the Board of Education all endeavored to check the undesirable tendencies, but among many counsellors the boy resembled not so much the stray dog of Tagore's illustration, but a dog with many masters. Official remedies seemed far away, and official methods bereft of that human sympathy and understanding which the boy required. Moreover, anything connected with the Government was suspect—it was too suggestive of repression and espionage.

Therefore a short time ago a band of leading employers, representing the largest industrial areas, decided to form an association to deal with the whole question of the welfare of the industrial boy. The objects of the Association are:

To encourage the study among employers of labor of questions affecting the welfare of boys in industry.

To assist employers of labor in starting schemes for promoting the welfare of their boys.

To arrange meetings and conferences, and to publish a magazine for the exchange of views and experiences with regard to the above questions.

To establish an information bureau for employers of labor with regard to the above questions.

To find and train men to occupy positions as Welfare Supervisors for Boys.

Under the scheme of welfare work prepared by the Association, and which is in operation in many of the largest factories, shipyards and steel mills in the country, the following duties are being carried out by the Boys' Welfare Supervisor.

Engagement. While the supervisor endeavors to make the entry of a new boy into industry as important and as formal as possible, yet he tempers the incident with humanity. Instead of the boy calling at the time-keeper's office, being interviewed, or not, by his future foreman, and pitch-forked into a job, he is asked to complete a form giving particulars of his parentage, education, health, etc. References are taken up; the home visited; the nature and the importance of his future work explained to him, and, in short, he is made to feel that he has a part, and a very important part, to play in the firm with whom he is about to work for their mutual good.

In addition, the supervisor arranges to be present at the medical examination, which, under the Factory Acts, is required to be made by the certifying surgeon within seven days of a boy's engagement. Too often this examination has been allowed to degenerate into a farce, with the result that boys have been engaged upon work of which they were physically and mentally incapable.

The supervisor makes notes of the certifying surgeon's recommendations with regard to such things as treatment for adenoids, light work for suspected cases of hernia, the provision of glasses, treatment for dental trouble, and endeavors to see that such recommendations are carried out.

In works where boys have been imported from other districts the supervisor prepares a list of suitable lodgings, or, where need exists, arranges for the provision and supervision of a hostel for them.

Progress. Lest a boy should drift into a "blind alley" occupation, or, on account of his skill in a particular operation, be in danger of being retained by a short sighted foreman, the supervisor will, from time to time, receive a report on his progress from the foreman, and arrange where it is advisable for the boy to be transferred to other work in order that his knowledge of processes and methods may be increased.

Health. In cases of accident and sickness the supervisor will keep in touch with the boy in order to make him realize that the firm with whom he is working does not regard him altogether as a "hand," but with a deeper and more human consideration.

In many firms the supervisor is given the care of such helps to efficiency and cleanliness as overalls, clogs, gauntlets, and exercises oversight in connection with the sanitary, washing, and drinking arrangements.

Since recreation is essential to the well-being of the growing boy, and since it is of paramount importance that recreation, if it is to be effective, must be organized, the supervisor will arrange various schemes of play. He becomes the axis around which the sports club revolves, and the many activities incidental to the successful management of team games, inter-works leagues, etc., become important items in his weekly program.

In a few firms arrangements have been made, either by building, or hiring, away from the smoke and noise of the industrial centre, suitable premises where the boys can spend their week-ends or short spells in the summer instead of passing their leisure time in undesirable occupation in the city streets and courts. In other firms successful cadet corps have been established and the interest taken in such endeavors by the adult workers as well as the boys helps not a little to create that *esprit de corps* which in the past has been sadly lacking.

General. It is of vital importance that the man appointed to carry out the duties outlined above must possess certain distinct qualifications. There are many men to-day returning broken from the war, who, at the battle front, discovered that they possessed the power of leadership. This gift should not be lost to industry and it is hoped, as the boys' welfare movement develops, that such men will find a permanent place within the organization of every boy employing firm.

It must not be assumed that the activities referred to in this article are altogether new in British industry. In most firms in the past certain of these activities have found a place, but as a rule they operated in a disjointed, casual manner. Employers are now discovering that it pays in every way to centralize all boy activities in one definite person.

There is need to-day for a wider outlook, and for a new spirit, in the relationship between employers and workers—it is the one great modern need. Such a change of outlook and spirit can only be brought about by the operation of human influence and human effort. It is this the welfare supervisor endeavors to supply by acting as a greaser of the cogs and wheels of industry.

The Director of the Boys' Welfare Association, Sanctuary House, Tothill Street, Westminster, London, S. W. I., England, would welcome suggestions from readers who have had experience in boys' welfare work and would be glad to receive literature on the subject.

* * * *

Computing Labor Turnover

By Carroll W. Doten

Chief, Division of Industrial Hygiene and Engineering,
Pennsylvania Department of Labor and Industry

THE following reply to our questionnaire on labor turnover was received too late to print in the September issue.—THE EDITORS.

1. "Labor turnover" may be defined as the number of employees hired during a given period to replace employees who leave the service for any reason. It is usually expressed as a percentage of the average or mean force maintained during the period covered.

In one sense there is a close analogy between labor turnover and the turnover of material or working capital in any industrial establishment, but the analogy fails when it comes to the question of desirability. Every business man is keenly desirous of turning over his stock of goods or working capital as many times in the year as possible. In fact, the maxim is, small profits and quick returns; but in the case of labor turnover exactly the opposite condition is regarded as desirable.

2. (a) Turnover expressed as a percentage is computed by dividing the normal force, that is, the constant force, into the number of laborers replaced during any given period.

(b and c) With a varying force, whether increasing or decreasing, the method of computation is the same as under (a), except that it becomes necessary to take the average force or mean as the divisor. For short periods where fairly regular reduction or increase is going on the mean or average may be found with sufficient accuracy by adding the number at the beginning of a period to the number at the end and dividing the sum by two. If, however, the period is a long one and fairly rapid and irregular fluctuations occur in the force, it is highly desirable to have the number employed each week or even each day during the period and to add these figures together and divide by the number in the series.

3. If this question means the average on the payroll it has already been answered in the preceding question. If, however, it means daily attendance of persons on the payroll, it has no particular significance in the computation of turnover. The matter of irregular attendance is a distinct problem in itself and is a serious matter.

5. It does not seem to me that any elaborate mathematical formula is necessary for the diagnosis of the turnover conditions. It is a simple arithmetical problem so far as the obtaining of the percentage is concerned.

(a) A real diagnosis of turnover involves elements that are not mathematical and are not susceptible of mathematical determination or analysis. These factors are broadly social, economic and industrial. They cover the whole range of social unrest as well as business inefficiency. It would be idle, therefore, to attempt to generalize, with any idea that such generalization would be of any great value in specific instances.

* * * *

Questionnaire on Women in Industry

By Dr. Francis D. Patterson

Head, Industrial Service Department
Emergency Fleet Corporation

IN an effort to obtain adequate data upon the subject of the employment of women in industry due to the emergency of war, the questionnaire given below has been sent to about 1500 industrial physicians. Replies should be addressed to the writer at Third and North Streets, Harrisburg, Pennsylvania.

1. Do you employ women in manufacturing or other occupations within your plant? If so, in what occupations and how many women are employed.
2. Do you intend to replace men by women in other occupations in your plant ? If so, at what occupations and how many women will be employed?
3. Do you physically examine all women applicants for employment at the time of their employment?
4. Do you physically re-examine all women employees from time to time in order to determine accurately the effect of their industrial occupations upon their physical health?
5. Do you give men and women equal pay for equal work?
6. What are the working hours of your women per day? Per week?
7. Do you employ women on night shift? If so, how many?
8. What in your opinion are the occupations in your particular industry in which women should not be permitted to work?
    (a) By reason of danger to their health.
    (b) By reason of greater liability to accident.
9. Do you require your women employees to wear a uniform? Bloomers? Caps?
10. Do you require your women employees to wear any particular type of shoe?
11. Do you have any regulations with regard to the stockings worn by the women who wear bloomers?
12. What factory regulations, if any, have you issued with regard to the wearing of jewelry or other articles of personal adornment by your women employees?
13. Name of plant.
14. Location of plant.
15. Signature of physician.

Editorials and Comment

Look Shipyard Problems in the Face

WE are not getting as many ships as we need. Whose fault is it, the shipyard management or the workers? Theodore Roosevelt apparently blames the latter, for in a speech made at the launching of a steamer at Newburgh, New York, on September 2, he is quoted as saying:

> Yet it has been alleged to me that in certain yards men have loafed individually, and that in certain yards unions have actually limited the output, so as to limit the number of rivets driven in a day, or to limit the number of days that they worked, or otherwise to prevent the development of our full strength and our utmost speed.
>
> Such men are traitors to the country. If I had my way, I would take any such man, and any man who aided or abetted such a man, and put him in the army at once, and send him across the water to do the hardest work in the most dangerous position, and I would not give him a rifle until he had learned the spirit of patriotism.

But the American people believe that labor is essentially loyal—so why should shipyard workers be lashed in this fashion? Are the blows falling on the right shoulders? There may be evidences that some ship workers are lacking in loyalty and in appreciation of their responsibilities, but, after all, does not the chief fault rest with the managements of shipyards?

If labor was generally inclined to be obstructive and resist efforts to increase the output of ships, would there not be more of a similarity of results in the many yards?

There is much to support the contention that the fault is chiefly the lack of managerial efficiency at the head of many of the shipyards. If this were not so, then why the tremendous differences in results obtained by different yards? for, if labor generally were at fault, there would be more of a tendency to equal output.

It is very evident to the public from information that is published from time to time, that some yards take several times as long to finish vessels as others, and this fact cannot by any means be attributed to the attitude of labor. One can only conclude that there is something in the difference in management that enables one yard to complete boats so much faster than others. Why is it that some shipyards always seem to have a sufficient supply of steel and materials to conduct their shipbuilding activities, while other yards suffer from periodic shortages, compelling them to even lay off help?

Certainly the workers have nothing to do with such a situation and there must be some differences in management that account for such conditions.

Why the great diversity in numbers of men employed for the same requirements and why the great range in average output of rivets per hour at different plants?

Why do some yards have little difficulty in obtaining a sufficient supply of men to meet their needs, while others are perpetually short of such help?

Why are some yards able to secure a reasonably full attendance of their workers, and keep their labor turnover small while others have a large proportion of their help absent at all times, and are continually hiring?

It is perfectly obvious to any intelligent observer who may be aware of these differences in results that they are due entirely to differences in degree of efficiency of the management, and not to the employees themselves.

Evidently, the shipbuilding industry is about where the manufacturing industry was 20 years ago, in regard to management, and some yards are very much more highly developed in this respect than others.

Is it not time for shipbuilders to realize that their chief problem is management, and that by taking responsibility on themselves for existing conditions, and setting about to cure them by adoption of advanced ideas and methods, this industry can be put on a plane that will make it the equal of any other line of production.

Can any one, after grasping the significance of these questions, place the blame for low shipyard production on the shoulders of the worker? INDUSTRIAL MANAGEMENT thinks not.

The responsibility for weeding out the absentees, for bringing the average number of hours per week close to the regular operating schedule, for reducing the labor turnover, for employing workers efficiently, for utilizing a proportion of women, for scheduling materials, for supplying tools, for bringing the average of production nearer to what it is in a few noteworthy cases —the responsibility for all of these things rests upon the management of the yards and nowhere else. Once these responsibilities are taken and fulfilled, we will have ships; we will not have to think about more yards.

* * * *

Character Analysis

WHETHER we are favorably disposed to the matter, much is being said and something is being done in connection with character analysis as one of the instruments of management in industry. A few persons have widely advertised their own special gifts and abilities in picking men and women for jobs. Others have worked more quietly and perhaps with more effect. Still others have submitted the entire matter to careful analysis with the hope of discovering basic principles to assist in "putting round pegs in round holes" without amputating the corners of square pegs to make them circular.

Opposed to these few persons who have, or who claim to possess, the peculiar abilities necessary to determine fitness from external characteristics, are a large number of industrial executives and managers who scoff at using any such means. They have a very sound reason for their viewpoint. Human beings are apt to ride their own hobbies, and in every new movement there are always charlatans who try to spring into prominence and affluence. Character analysis in industry is new and, very properly, the honest skeptic may question if some of its advocates may not be seeking their own personal ends, instead of trying to help solve great, crying industrial problems. This objection cannot be spread over the efforts of all. There must be some who are honest in motive and who are trying to get results worth while. Admitting all this, there is still another question carrying with it the reason for an objection. How do the best of the character analysts obtain their results? Do they determine capability through an intuitive knowledge of character, or by applying definite principles that can be made a matter of record, taught to others and used by any one who knows and understands them.

If worth while results are obtained only through intuition, it is evident that they cannot be transmitted. Industrial managers would be justified in looking with doubt upon a proposal to introduce into their organization any methods of management that must fail or disappear, unless they are applied by a person with a particular kind of intuition. No method of management can safely rest upon anything except definite principles, capable of being applied by any one who is competent to understand them and to be an executive.

So the art of character analysis must be free from the charge that it is intuitive before it can hope to make any progress in industry. A definite group of principles must be discovered and declared in connection with it before it can command the respect of industrial managers.

In this issue Mr. George K. Parsons, on page 330 declares his belief in the existence of these principles and gives a few results from his own application of them. All that he says is worthy of careful reading.

Engineering Relationships

OLD ideas are slipping easily, just now. How far will engineers and industrial executives be able to slip away from the past and measure up to the opportunities of the present and future? There are hopeful signs that they will travel a long way on the path of progress.

The American Society of Civil Engineers has appointed a committee on development, and the opening sentences in the resolution providing for its work are: "The development and application of the sciences in recent decades have caused profound changes in the social and industrial relationships of all peoples. The engineer has been a leader in this progress. Sociological and economic conditions are in a state of flux and are leading to new alignments of the elements of society." So the civil engineers are to set apart a time at their meeting of January next to consider a report from this committee on what the purposes and activities of their great organization should be.

A similar movement is under way in the American Society of Mechanical Engineers and the American Institute of Mining Engineers. What an opportunity for far sighted statesmanship! What magnificent results may come if the path of progress is blazed with vision and leadership!

Heretofore, the engineer has been a hired man, and hired men do not control, nor direct, nor lead. So if the engineer is to become a leader as an individual, and if engineers as a group are to influence events in a major degree, they must cease to look at things from the viewpoint of hired men. They must judge, preplan and control as those who are masters instead of servants.

How long a period of education and inspiration must pass before engineers and industrial executives as a great class will have and act from the *will to lead*.

Engineers as a group of professional men are following this flux of relationships. They realize that their relations to community and state, to industry and trade, and to their brother engineers are on the change; but as yet no one has pointed out the direction of progress, no one has brought inspiration through revealing the goal, no one has crystallized into accepted words the objects and aims that should be striven for by the present generation of engineers.

Will parts of the program as finally laid down for action be: The demand for maximum production of every needful thing to upbuild and support civilization; the elimination of every form of wastage of natural material and precious human effort; the requirement that everything should be produced at essential cost so that every one can share largely in the good things of life, that idleness of equipment and men shall give way to activity; the demand that distribution shall be as effective as production; that engineering work shall be done by engineers; a recognition that serving the public is the highest duty of every engineer, and that it is better to serve than to profit; a recognition of the human forces of industry and the spirit of the finest kind of democracy—a willingness to help every one develop and reach his highest degree of self-expression, and, even more, active support and assistance of him in his self-development.

Perhaps, during the next few months some of these ideals may be written into the aims and objects of the great engineering societies of the United States.

* * * *

Back Up Your Boy in France

"HOW I wish I could go to France and back up the boys!" How many times we hear older men say things like this.

In some walks of life men can leave business in the present emergency and go. But this is not true of executives in industry. They must stay by the work and "keep the home wheels turning." But nevertheless their desires are just as keen as those of other men, to do something actively and personally on or behind the fighting lines.

To be sure several thousand men have found places in some of the associated services of the army, as in Y. M. C. A. work, and in agencies that are working for the upholding of the morale of the fighting men by contributing to helpful pastimes for leisure hours. In this particular direction there is still a great need.

Just now there is an insistent demand for men for the Y. M. C. A. transport service. At the request of the army authorities the association has taken over all of the canteen work and is doing a business of some $5,000,000 per month. This entails a tremendous amount of transport, involving the repair, upkeep and driving of a large fleet of automobile trucks. Men are urgently needed for both sides of the service, that is for the work of repair and the work of driving. The latter has in it all of the elements of adventure that is found in the regular transport service in the army, for there are Y. M. C. A. dugouts directly behind all of the front line trenches. So to industrial executives and engineers there is a double plea. First, a plea to leave your business, if you can, and in this transport service back up the boys in France; or, second, if you cannot leave your business, send as your own substitute a man qualified either to repair or drive and in this personal way back up the boys in France.

* * * *

Progress of Employment Management

THE profession of employment management is surely a lusty infant. Formally christened last May at the Rochester Conference, he is now the presiding genius of nine war emergency courses in as many educational institutions located in six of our great cities, stretching from Boston, Massachusetts, on the East to Berkeley, California, on the West. He has brought to his help the following Government departments:

The Department of Labor
    War Labor Policies Board
    United States Employment Service
    Woman-in-Industry Service
The War Department
    Ordnance Department
    Quartermaster General
    General Staff
        Commissioner on Education
    Adjutant General's Office
        Commissioner on Classification
The Navy Department
The United States Shipping Board
    Emergency Fleet Corporation
Chamber of Commerce of the United States

His courses deal chiefly with the broad problems of employment management. However, consideration is given to statistics, labor economics, business organization and industrial management. The material presented on the subject of employment management covers the organization and equipment of an employment department, the hiring of workers, training of the workers, wage payment systems, control of working conditions, and the government of the shop. Courses of instruction run from six weeks to two months.

Courses already completed have contained students representing the following industries: Shipbuilding, cotton manufacture, woolen manufacture, clothing, castings, hardware, automobiles, refining of oil, arsenals, manufacture of explosives, shoe making, manufacture of chemicals, rubber goods, building materials, electrical machinery, industrial gases, machine tools, manufacture of jute, cement, tanning, manufacture of silverware, candy making, smelting and refining, lithographing, manufacture of optical instruments, furniture, munitions, airplanes and paper.

Truly, no profession has had such a lusty growth as this latest arrival in the industries.

Factory Equipment News

The Latest Labor-Saving Machinery

The Servis Truck Clock

A RECORDING instrument that plots a diagram of operation and waits on motor trucks has been placed on the market under the name of the Servis truck clock. The instrument is attached to the truck in such a way that the side swaying of the vehicle swings a pendulum to which is attached a stylus near its point of suspension. This stylus produces a mark and thus a continuous record on a chart that is rotated by a clock movement.

As the pendulum swings only when the truck is in motion the stylus only records the time during which the vehicle is moving.

THE SERVIS TRUCK CLOCK
Service Recorder Co., Cleveland, O

An analysis of the chart shows the successive periods of running and standing times so that the truck superintendent or inspector can identify various trips and stops showing how long a time was required for loading, traveling, unloading and so on.

This instrument is built by the Service Recorder Company, Cleveland, O.

* * * *

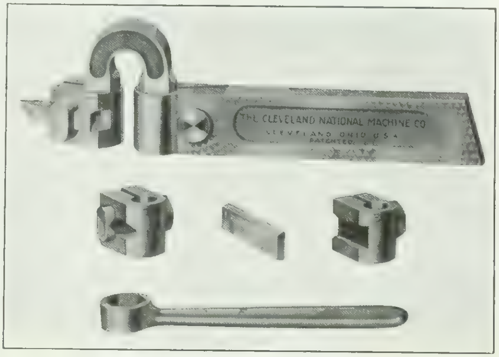
Spring Head Tool Holder

A TOOL holder designed with a spring head to relieve chatter is manufactured by the Cleveland National Machine Company, Cleveland, Ohio. The accompanying illustration shows its features of construction.

Each holder has three tool clamps taking regular cutter stock—flat 3/32 x 7/16 inch; round 3/16 to 5/16 inch; square 5/16 inch. These clamps are interchangeable and can be inverted to throw the tool on either side of the holder. Bits as short as ⅝-inch long can be used. Parting tools as thin as 0.014 inch can also be used.

The tension of the spring is sufficient satisfactorily to cut ordinary pitches of thread on all grades of tool steel.

The entire holder is made of forged steel, tempered and polished. Turning to the illustration *A* is the shank; *B* the goose neck spring; *C D E* the three clamps; *G* a square bit and *F* the tool-holder wrench.



SPRING HEAD TOOL HOLDER
Cleveland National Marine Company

* * * *

By an unfortunate omission, the article on factory lunchrooms, appearing on pages 254 and 255 of the September issue of INDUSTRIAL MANAGEMENT, failed to make mention of the fact that the illustrations were supplied through the courtesy of Albert Pick & Company, Chicago, Ill., in whose behalf we take this opportunity to correct the error.

* * * *

Personal and Business Items

The Sarco Company, Inc., New York City, has opened a new office at Atlanta, Georgia, under the management of Mr. C. R. Dunwoody.

* * * *

The Jeffrey Manufacturing Company, Columbus, Ohio, has reopened a Cleveland branch office in charge of Messrs. P. C. Dierdorff and C. B. Reed.

* * * *

The Poole Engineering & Machine Company, Baltimore, Md., is mailing folder No. 203 briefly describing the application of the "Turbo Gear" to mine fan drive.

* * * *

The Lakewood Engineering Company announces the opening of new offices in Chicago, in the Lumber Exchange Building.

* * * *

The Chas. T. Topping Machinery Company has merged its interest with the Pittsburgh office of the Lakewood Engineering Company, Cleveland, O.

* * * *

Pneumercator Company, Inc., has moved its New York office into larger quarters in the Park Row Building.

Mr. Robert Mawson on September 23 took up the duties of Production Manager of the Mosler Safe Company, Ordnance Department, Hamilton, Ohio.

* * * *

Mr. Vance McCarthy, for the past twelve years' Pittsburgh branch manager of Edward R. Ladew Company, Inc., has been appointed general sales manager of the same company with headquarters in the New York office.

* * * *

The Cutler-Hammer Manufacturing Company, Milwaukee, Wisconsin, announce the opening of a branch office in the Union Trust Building, Washington, D. C. Messrs. H. W. Knowles and C. W. Yerger will be in charge.

* * * *

Mr. Leonard W. Egan, formerly special engineer with the Wellman-Seaver-Morgan Company, has become associated with the Electric Furnace Company, with headquarters at their general offices in Alliance, Ohio.

* * * *

Mr. D. P. Cartwright has been appointed manager of the New York branch of the North East Electric Company, to succeed Mr. R. J. Hardacker, who is shortly to assume the management of the Chicago branch.

* * * *

Mr. Leon F. Hussey has recently become advertising manager of the General Fireproofing Company, Youngstown, Ohio, leaving the Oakland Motor Car Company, Pontiac, Michigan, which he has served in a similar capacity during the past two years.

* * * *

The Chicago Pneumatic Tool Company announces the appointment of Mr. C. W. Cross as special representative for the sale of pneumatic tools to railroads, taking the place of Mr. L. C. Sprague promoted to be district manager of sales for the company at New York.

* * * *

The Wheeler Condenser & Engineering Company, Carteret, New Jersey, has just issued a bulletin No. 112-A, entitled "Condensers, Pumps, Cooling Towers, etc." A helpful part of the discussion relates to the choice of the kind of condenser and the remainder illustrates and describes the Wheeler condensing machinery in detail.

* * * *

The Hayward Company, of New York City, will exhibit this month at the Foundrymen's Convention in Milwaukee working models of their clam shell and orange peel buckets, and will also have in operation an electric motor bucket of the type which has been adapted for foundry use. The exhibit will be in charge of Messrs. C. F. Hutchings and H. M. Davison.

* * * *

The Griscom-Russell Company, New York City, has just issued Bulletin No. 1110 describing the Stratton Air Separator in somewhat more detail than the previous pamphlets. The construction of the separator is shown, its method of installation described and two pages of diagrams and tables give the dimensions for the various sizes.

* * * *

Mr. W. T. Nevins, formerly general superintendent of the Buffalo Dry Dock Company (American Shipbuilding Company), and of recent years marine architect and ship surveyor of Chicago and San Francisco, has been appointed superintendent of ship construction of the Chickasaw Shipbuilding Company, the United States Steel Corporation plant now in process of construction at Chickasaw, near Mobile, Ala.

* * * *

The Pangborn Corporation, Hagerstown, Md., has just issued bulletin No. 50 entitled "Sand Blast—Principles and Data." The matter lives up to its title describing first the various systems of sand blasting, telling how they are applied, describing various types of apparatus and giving information in regard to all of the equipment for a sand-blast installation.

* * * *

The Brown Portable Elevator Company, Chicago, Illinois, has just issued a new catalog—Bulletin No. 2—entitled "Cutting Costs by Continuous Motion Handling Machines." It is devoted to illustrating the use of hoisting and conveying machinery made by this firm with particular application to the saving and efficient using of utilization of man power. Sixty-six illustrations show a wide variety of applications in many different industries.

* * * *

The Chicago Pneumatic Tool Company announces that a contract has been let and work started on the erection of an addition to their Cleveland plant, which is planned to double the present output. It is expected that work will be completed on the building itself about November first. The necessary equipment has been ordered and it is believed will be delivered and ready for installation by the time the building is completed, so that the additional production contemplated will be available very soon thereafter.

* * * *

The American Bronze Corporation, Berwyn, Pennsylvania, gave a house warming on August 16 in celebration of its new plant at Berwyn. The new structure more than triples the firm's former capacity. A feature of the festivities was the announcement of a bonus plan for the employees. Briefly, this is a recognition of service under which each employee is awarded a bronze war worker's badge, which at the end of 30 days is exchanged for a silver badge provided the employee has rendered faithful and loyal service. After holding the silver badge for one month, each employee will receive a cash bonus, which will continue for a period of six months, at the end of which time a gold badge is awarded with the name of the owner engraved thereon. The gold badge entitled its possessor to the cash bonus during the entire period of his employment provided he qualifies under the regulations of the plant.

* * * *

A contract for the construction of the new shipyard of the Bethlehem Shipbuilding Corporation, to be located at Alameda, California, has been awarded to the Aberthaw Constructios Company, Boston, Massachusetts. The Alameda plant will be the second largest in the United States, exceeded in size only by Hog Island. It will be twice the size of the Victory plant at Squantum and will involve twice the expenditure. The plant, which will be complete for building on ten slips, will cover over a third of a square mile and from three to four million yards of dredging will be necessary. Large cargo vessels will be constructed, contracts for which have already been awarded to the Bethlehem Shipbuilding Corporation by the United States Shipping Board. The formal opening of the work occurred on August 13, when the first pile was driven; it is anticipated that the construction work will require the service of approximately 15,000 men within the next few weeks.

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war. The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. The Explanatory Note is given in the Index Section of INDUSTRIAL MANAGEMENT, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Agriculture

The Tutored Farmer (88188 A). W. O. Hedrick. 3000 w. Sci M—Aug., 1918. Activities for the instruction of farmers, and results.

Apprentices

Fundamentals of Apprenticeships. National Interest Grows—I (87994). 4000 w. Can Fndman—July, 1918. Serial, 1st part. Requirements of industrial education.

The Education and Training of Engineering Apprentices (87973 A). P. H. S. Kempton. 1000 w. Elec Rev—July 19, 1918. Serial, 1st part. Account of some of the systems of training.

Boiler Rooms

Education of Boiler-Room Men Necessary (88353). Edwin A. Hunger. 3500 w. Elec Wld—Aug. 24, 1918. Importance of human element in fuel conservation.

Coal Mining

Coal-Mining Instruction in the Evening Schools of Derbyshire and Leicestershire (87905 A). George Forster. 4000 w. Ir & Cl Trds Rev—July 12, 1918. Explains scheme of instruction.

Colliery Managers

Examinations for Colliery Managers' Certificates of Competency (87885 A). 3000 w. Ir & Cl Trds Rev—May 31, 1918. Papers from Board for Mining Examinations, at the Home Office.

Disabled Men

The Vocational Re-education of Disabled Men (88151). C. A. Prosser. 1200 w. West Eng—Aug., 1918. Plans of Federal Government for training disabled veterans.

Engineers

Engineers and the War (88218 D). William M. Black. 12 pp. A I E E, Pro—Aug., 1918. Nature of the work of the engineer and the preparation required.

The Training of Engineers (88148). E. J. Silcock. 3500 w. Can Engr—Aug. 8, 1918. Introduction to discussion by the Institution of Water Engineers, England.

Industrial Census

What an Industrial Census Can Do (88447 A). Dale Wolf. 3500 w. Ind Man—Sept., 1918. Results of an experiment of the Miller Lock Co., Phila.

Industrial Chemistry

Organic Chemistry in Relation to Industry (87982 A). M. O. Forster, with discussion. 8500 w. Roy Soc Arts, Jl—July 12, 1918. Claims its study satisfies most forms of intellectual craving, and is highly remunerative when applied to industrial processes.

Laboratory

The National Physical Laboratory in 1917-18 (88396 A). 4500 w. Engng—July 26, 1918. Serial, 1st part. Editorial review of its history and development, as given in the last Report.

Power Plants

Modern Power Plant Education (87869). C. A. Joerger. Ills. 1500 w. Power—July 30, 1918. The co-operative course for engineering students at the University of Cincinnati.

Research

Research and the Industries (88187 A). P. G. Nutting. 2500 w. Sci M—Aug., 1918. Value of industrial research and the training needed.

Research Associations (87887 A). 3000 w. Engr—June 28, 1918. Examines the question of their organization and principles.

Shipyards

Training Shipyard Workers (88180 B). James A. Pratt. 3000 w. Cas Eng Mthly—July, 1918. Outlines a plan for training large numbers of the semi-skilled class.

Shipyard Labor (88417). 1100 w. Times Engng Supp—July, 1918. Recent efforts to expedite work in British yards.

Training

Training 150 Operators Per Week (88268). 2500 w. Auto Ind—Aug. 15, 1918. How the vestibule school of the Remington Arms Co. is meeting the demand for skilled workers of both sexes.

Women Workers

Selection, Training and Supervision of Women Workers (88335). Ills. 2500 w. Auto Ind—Aug. 22, 1918. How high employment standards are maintained.

Women's Work in Munitions (88419). 1300 w. Times Engng Supp—July, 1918. Description of work shown at second Exhibition of technical work by women.

FINANCE AND COSTS

Accounting

A Foundry Cost and Accounting System (87963 A). 3500 w. A S M E, Jl—Aug., 1918. Discussion of W. W. Bird's paper.

Corporation Organization and Accounting (88191 A). William H. Bell. 10 pp. Jl Actcy—Aug., 1918. Serial, 1st part. Deals with matters affecting private corporations conducted for profit.

Liberty Loan Accounting for Small Banks (88190 A). Willard H. Lawton. 1500 w. Jl Actcy—Aug., 1918. System adopted for a small trust company.

Airplanes

Airplane Cost Finding (88443 A). C. H. Hart. 700 w. Ind Man—Sept., 1918. A simple method of recording costs.

Copper Mines

Depletion of Copper Mines in Relation to Income Tax Returns (88189 A). William B. Gower. 11 pp. Jl Actcy—Aug., 1918. Accounting in relation to the depletion of mineral deposits.

Cost Keeping

Cost Keeping System for County Highway Work (88090). H. A. Sewell. 2500 w. Eng & Con—Aug. 7, 1918. Abstract of paper before Washington Assn. of County Engrs. Principles of such systems.

Some Notes Regarding Foundry Cost-Keeping and Methods (87993). M. H. Potter. 2500 w. Can Fndman—July, 1918. Elements of the system. Factors entering into the problem.

Germany

Planning Economic Supremacy (88348). 3500 w. Naut Gaz—Aug. 24, 1918. How Germany hopes to regain her lost markets. Paper issued by the Guaranty Trust Co. of New York.

Income Tax

Pay the Income Tax in Installments (88456 A). J. P. Brophy. 500 w. Ind Man—Sept., 1918. A reasonable plea for relieving financial strain.

Labor Costs

Report on Estimating Labor Costs (87849). 7 pp. Elec Rev, Chi—July 27, 1918. Compiled by the Electrical Estimator's Assn. of Chicago, and presented at the Cleveland convention of the National Assn. of Electrical Contractors and Dealers.

Living Cost

How to Determine Cost of Living in An Industrial Community (88438 A). Ray M. Hudson. 4500 w. Ind Man—Sept., 1918. Tabulated analysis of the elements of living cost, with comments.

Piecework

Determining of Piecework Rates from Charts (88470 A). Otto M. Burkhardt. 1000 w. Am Mach—Aug. 29, 1918. A simple method of figuring prices when the time elements are known.

Trade

The Proper Basis for a Prosperous Foreign Trade (87805). John L. Harrison. 3000 w. Ry Age—July 26, 1918. Interesting views of one who has spent several years in Asiatic countries.

United Kingdom

The Economic Condition of the United Kingdom After Three and a Half Years of War (88375 A). Edgar Crammond. 2d Cantor lecture. 7000 w. Roy Soc Arts, Jl—Aug. 2, 1918. Serial, 1st part. Outlines the principal economic changes which occurred.

Valuation

Valuation for Rate-Making (88270). J. K. Johnston. Read before Indiana Ind. Tel. Assn. 2500 w. Telephony—Aug. 17, 1918. Question of a reasonable return on the basis used by courts and commissions to determine rates.

Wages

Public Service Says Living Wage Is $1115 (88034). 2000 w. Elec Ry Jl—Aug. 3, 1918. Claims that present wages give an adequate living standard.

Remuneration of Labor and Its Relation to Output (88179 B). John Holloway. 9 pp. Cas Eng Mthly—July, 1918. Discusses the various methods and their relative advantages.

The Recent Increases in Wages of Shopmen (88100). 2500 w. Ry Age—Aug. 9, 1918. Supplement No. 4 to Order 27 defines trades, names new rates and contains statement.

MANAGEMENT

Business

Business Principles—A Discussion (88446 A). Harold Bates. 5000 w. Ind Man—Sept., 1918. Critical discussion of a point in C. E. Knoeppel's article in July issue.

Significant Changes in Business Management (87925 A). 3000 w. Am Mach—Aug. 1, 1918. Changes occurring in the relations between labor and capital.

Control

Graphic Production Control—I (88436 A). C. E. Knoeppel. 3000 w. Ind Man—Sept., 1918. Serial, 1st part. Advantages of the use of graphic methods for recording and controlling industrial production.

Efficiency

Criticism and Individual Efficiency (88461 A). Lieut. R. T. Strong. 1200 w. Ind Man—Sept., 1918. How both public and personal efficiency may be improved.

Efficiency—Stop! Look! Listen! (88458 A). William H. Smyth. 1500 w. Ind Man—Sept., 1918. Warning against the ideals of materialism.

Factories

Factory Investigations (87878 A). Albert A. Dowd. 1500 w. Machy—Aug., 1918. Reasons for employing outside experts, and methods of conducting investigations.

File Industry

Reform in the File Industry (87940 A). George Taylor. 3500 w. Engr—July 5, 1918. Discusses the factories, the methods, and the management.

Labor

Man Power of the Future (88046 B). Harry Tipper. 2200 w. S A E, Jl—Aug., 1918. The force of labor idealism.

Home Attractions Keep Track Laborers Satisfied (87852). Clifford A. Elliott. Ills. 1800 w. Elec Ry Jl—July 27, 1918. Ways of solving the labor problem, by the Pacific Electric Ry.

Getting Together (88460 A). William Judson Kibby. 1200 w. Ind Man—Sept., 1918. Disadvantages of antagonisms between employers and workmen.

Unity Versus Trade Unionism (88439 A). L. L. Warren. 1500 w. Ind Man—Sept., 1918. A plea for coöperation by employers and unions.

The Problem of Industrial Unrest (88130 A). 1200 w. Aust Min Std—June 27, 1918. The moral value of work.

The Problem of Industrial Unrest (88138 A). R. F. Irvine. 1500 w. Aust Min Std—July 4, 1918. Serial, 1st part. The political economy of masters.

The Problem of Industrial Discontent (88131 A). J. H. Butters. 3000 w. Aust Min Std—June 20, 1918. Suggestions for industrial reconstruction after the war.

Labor-Maintenance

Beginnings of Labor Maintenance Service in a Small Plant (88442 A). Mary L. Morris. 2500 w. Ind Man—Sept., 1918. How it can be adapted to the needs of the small plant.

Labor Turnover

Labor Turnover (88463 A). 400 w. Ind Man—Sept., 1918. Editorial on points in the symposium given.

Computing Labor Turnover (88462 A). 7000 w. Ind Man—Sept., 1918. A questionnaire on labor turnover.

Merchant Marine

See same heading under MARINE AND NAVAL ENGINEERING.

Piecework

See same heading under Finance and Costs.

Production

Keeping Track of Production (88457 A). H. A. Russell. 3000 w. Ind Man—Sept., 1918. Useful forms for recording progress of work.

Stock Storing

Economic Factors Connected with Storing (88225 A). H. B. Twyford. Ills. 2500 w. Iron Age—Aug. 15, 1918. Discusses the proper quantities of materials and supplies to keep in stock.

Switzerland

Le Dévellopement Industriel De La Suisse Depuis La Guerre (88428 B). L. De Launay. Ills. 2800 w. La Nature—July 13, 1918. Industrial development of Switzerland during the war. Former watch factories now making shells for France.

Time Studies

Time Studies for Rate Setting on Gisholt Boring Mills—III (88437 A). Dwight V. Merrick. Ills. 2000 w. Ind Man—Sept., 1918. Continuation of the timing of operations for moving head, securing tool and making cut.

Wastes

Industrial Waste Produced (88411). 1700 w. Times Engng Supp—July, 1918. Waste Products and how they are reclaimed.

Prevention of Waste vs. Reclamation of Scrap (88015 A). Henry J. Miller. 1500 w. Ry Mech Engr—Aug., 1918. Discussion of the scrap problem.

REGULATION

Arbitration

Arbitration Act Reform (88139 N). 5000 w. Cr Min West Aust, Mthly Jl—April, 1918. Outlines directions in which Australian arbitration laws should be reformed.

Compensation Law

Court Decisions on Workmen's Compensation Law, August, 1916—May, 1918 (88174 N). 370 pp. N Y Dept Labor, No. 87 Part 1—June, 1918. Covers subjects of constitutionality and coverage.

Emigration

Britain's Emigration Bill (87819). 2200 w. Naut Gaz—July 27, 1918. Objectionable features of the measure.

Employment

Federal Employment Bureau for Unskilled Labor in War Industries (88154). 1600 w. West Eng—Aug., 1918. Manufacturers working on war-contracts and employing over 100 workers must obtain unskilled labor through Federal Employment Service.

Engineering Appliances

The Overseas Distribution of Engineering Appliances (88384 N). Leonard Andrews, with discussion. 23 pp. Instn E E, Jl—June, 1918. Suggestions for advancing British engineering industries.

Engineers

The Status of the Engineering Profession and Fees (88157 D). 2500 w. Okla Soc Engrs, Trans—Vol. IV, 1918. Responsibilities, service and compensation.

Fuel Saving

War Conservation of Power and Light (88128 A). Charles E. Stuart. 3500 w. E Cb Phila, Jl—Aug., 1918. Plans laid out by the Bureau of Conservation of the U. S. Fuel Administration.

Labor

Labor Board's Award in Bethlehem Case (88073 A). 2000 w. Iron Age—Aug. 8, 1918. Decision and award in full. Summary of investigation of conditions.

Strong Plea for Permanent Adjustment (88074 A). 2500 w. Iron Age—Aug. 8, 1918. Abstract of brief filed with National War Labor Board. Bridgeport manufacturers protest against abandoning methods of demonstrated efficiency.

Labor Laws

New York Labor Laws Enacted in 1918 (88175 N). 66 pp. N Y Dept Labor, No. 88—June, 1918. Text of amendments to the labor law and workmen's compensation act.

Organization

An Industrial Democracy (87927 A). Ellsworth Sheldon. 1500 w. Am Mach—Aug. 1, 1918. Account of an interesting factory organization at the plant of Wm. De Muth & Co., Richmond Hill, N. Y.

Trusts and Combines (88182 B). E. T. Good. 2500 w. Cas Eng Mthly—July, 1918. Growth of export trade.

Packers

Suggests Railroad Administration Control for Packers (88249). 2500 w. Ry Age—Aug. 16, 1918. Report of Federal Trade Commission charges the five largest packers with operating a monopoly.

Patents

Patents (88146). Robert Hadfield. Excerpts from presidential address to Soc. of British Gas Industries. 4000 w. Can Engr—Aug. 8, 1918. Importance of wise and liberal patent laws American and English practice, etc.

Post-War

British Post-War Industrial Plans (88098). 2000 w. Auto Ind—Aug. 8, 1918. Recommendations as to methods to be pursued during the reconstruction period.

Power

Mastering Power Production—VIII (88448 A). Walter N. Polakov. 5000 w. Ind Man—Sept., 1918. Detailed analysis of operation and efficiency.

Public Utilities

Commission View of Utility Control (88069). Charles E. Elmquist. 4000 w. Telephony—Aug. 3, 1918. Commission control of public utilities.

What Commissions Are Doing on Rates (87824). 2000 w. Elec Wld—July 27, 1918. Conditions in California.

Railway Contracts

Urges That Draft Contract for Federal Railway Operation Is Unfair (87954 A). 2500 w. Eng News-Rec—Aug. 1, 1918. Features of the tentative draft of agreement not acceptable.

Time Zones

Proposed New Boundaries for Standard Time Zones (87935). Emerson W. Judd. 2500 w. Ry Age—Aug. 2, 1918. Plan for relieving all large cities of the double time standard.

Trade Bureau

The British Trade Bureau (88181 B). Alexander Jack. 2000 w. Cas Eng Mthly. July, 1918. The problem of developing export trade.

Trade Secrets

Secrecy Versus Coöperation (88459 A). Robert Mawson. 1200 w. Ind Man—Sept., 1918. Methods often practiced in the days of small shops.

War Work

Lining Up War-Work Possibilities of the Various Industries (88471 A). C. W. Stark. 1500 w. Am Mach—Aug. 29, 1918. A new government agency.

WELFARE AND SAFETY

Crippled Workers

The Cripple's Ability as a Metal Worker (87933 A). Douglas C. McMurtrie. Ills. 2000 w. Iron Age—Aug. 1, 1918. Analysis of operations for one-armed or one-legged workers.

Fire Protection

"Safety First" in a Large Factory (87972 A). Ills. 2500 w. Eng Rev—May, 1918. The fire-fighting system and the fire organization of the Schenectady works of the General Electric Co.

Malaria Control

Southern Railroads and the Problem of Malaria Control (88296). R. C. Derivaux. 2000 w. Ry Rev—Aug. 17, 1918. Importance of drainage and use of screens on bunk cars and houses.

Munition Workers

Health of Munition Workers (88410). 3400 w. Times Engng Supp—July, 1918. Report of British Committee.

The Health of Munition Workers (87899 A). 3500 w. Engng—July 5, 1918. Editorial review of the committee report concerning conditions.

Oil Infection

Infection from Cutting Oils (88164 N). Ills. 9 pp. Trav Stand—July, 1918. Dangers from unsanitary conditions.

Rescue Work

Mine Rescue Work (87841 B). H. D. Trounce. Ills. 16 pp. Prof Mem—July-Aug., 1918. Deals particularly with military mining, use of reviving apparatus for rescue of gassed men, etc.

Santa Fe Ry.

Development of Santa Fe Reading Room System (87804). Charles E. Parks. Ills. 2500 w. Ry Age—July 26, 1918. Reasons for its establishment, and the good results.

MISCELLANY

Engineering Industries

The Health of the Engineering Industries (88386 A). 3500 w. Eng Rev—July, 1918. The recently issued report of the Board of Trade Committee appointed to consider the position of the engineering trades after the war is summarized and discussed.

Inventions

British, French and Americans as Leaders in Engineering and Inventing (87916). 1800 w. Eng & Con—July 31, 1918. Claims that Germany has to its credit fewer inventions than any one of the three nations.

Russia

Conditions in Rusia (87858). Fedor F. Foss, with editorial. Ills. 4500 w. Min & Sci Pr—July 27, 1918. Address before the Engrs' Club of San Francisco. Explains conditions and discusses how to assist in reconstruction.

Salesmanship

Engineering Salesmanship (88493 A). Charles W. Hunt. Abstract of a paper before Manchester Assn. Engrs. 1700 w. Machy—Sept., 1918. First principles, etc.

War

Today's After War Responsibilities (88464 A). 800 w. Ind Man—Sept., 1918. Editorial on the responsibility of today.

MECHANICAL ENGINEERING

AERONAUTICS

Aeroplanes

The Roland Single Seater Fighter (88264). Ills. 1200 w. Auto Ind—Aug. 15, 1918. Mechanical details.

Aerostatics

Military Aerostatics (88111). H. K. Black. Ills. 700 w. A A Wkly—Aug. 12, 1918. Serial, 1st part. Balloons.

Aircraft

Products of the Royal Aircraft Factory (88097). Ills. 1000 w. Auto Ind—Aug. 8, 1918. Models developed at the establishment of the British government.

Airplane Details

Strut Sockets and Other Sheet-Metal Airplane Fittings (88079 A). Fred H. Colvin. Ills. 1000 w. Am Mach—Aug. 8, 1918. Details of operations on several complicated pieces.

A New Method for the Testing of Airplane Wing Ribs (87816). Irving H. Cowdrey. Ills. 4000 w. Auto Ind—July 25, 1918. Describes apparatus employed.

Airscrew

Notes on Airscrew Analysis (88361). M. A. S. Riach. 3000 w. A A Wkly—Aug. 26, 1918. Investigations.

Aviation

Organization of the German Army Aviation Service (88095). Ills. 1200 w. Auto Ind—Aug. 8, 1918. Four classes for bombing and reconnaissance.

The Present State of the German Aviation Programme (87825). E. H. Sherbondy. 1500 w. A A Wkly—July 29, 1918. Types of planes, armament, and other information.

Biplanes

The De Haviland IV Biplane (87978). Ills. 2000 w. Auto Ind—Aug. 1, 1918. Details of British long-distance reconnaisance and bomb-dropping machine.

The German H. W. Biplane (88112). Ills. 1200 w. A A Wkly—Aug. 12, 1918. Interesting features of the Hannover.

Bombing

"Laying the Egg on the Hun" (88096). Ills. 1500 w. Auto Ind—Aug. 8, 1918. The training of a bomber

The Problems of Aerial Bombing (88336). Ills. 2000 w. Auto Ind—Aug. 22, 1918. Details of bombs, bombing and bomb carrying.

British Machine

The S. E. 5A Single Seater Fighter (88334). Ills. 1000 w. Auto Ind—Aug. 22, 1918. Mechanical details of British machine which has been adopted by U. S. army authorities.

Design

Aeroplane Design (88424). W. F. Durand. 2500 w. Times Engng Supp—July, 1918. Problems discussed in lecture at British Aeronautical Society.

Official Guide for Airplane Inventors (88266). 2200 w. Auto Ind—Aug. 15, 1918. Possibilities for inventions and improvements in aircraft design as stated by Naval Consulting Board and the War Committee of Technical Societies.

Engines

Modern Aeronautic Engines ([illegible] B). Herbert Chase. Ills. 5 pp. S A E Jl—Aug., 1918. Serial, 1st part.

To avoid error, please order by title and number only.

Developing the Hispano-Suiza Motor for the Air Service (88284). George H. Houston. Ills. 600 w. A A Wkly—Aug. 19, 1918. Story of the invention of this engine by a Swiss engineer.

German Planes

L'Evolution De L'Aviation Allemande (88429 B). J. A. Lefranc. Ills. 3100 w. La Nature—July 27, 1918. Fourth article on German machines. Controllers, instruments, respiratory apparatus, etc.

Italy

Plans and Accomplishments of the Italian Air Service (88267). Ills. 1800 w. Auto Ind—Aug. 15, 1918. Italy is supplying all its own needs in motors and planes, but must have American raw materials.

Mufflers

Exhaust Headers and Mufflers for Airplane Engines (88043 B). Archibald Black. Ills. 5 pp. S A E, Jl—Aug., 1918. Data collected on this subject. Typical constructions, designs, etc.

Propellers

Characteristics of the Aerial Propeller (88360). S. E. Slocum. Ills. 2000 w. A A Wkly—Aug. 26, 1918. Serial, 1st part. Results of experiments, with formulas.

Conventional Propeller Calculations (88042 B). F. W. Caldwell. Ills. 10 pp. S A E, Jl—Aug., 1918. Shows how calculations for determining strength and efficiency should be made.

Predicting Strength and Efficiency of Aeroplane Propellers (87989). F. W. Caldwell. Ills. 2000 w. A A Wkly—Aug. 5, 1918. Charts and formulae for calculating h. p. absorbed and torque delivered at given engine and plane speeds.

Propulsion

Air Propulsion (87062 A). Ills. 5500 w. A S M E, Jl—Aug., 1918. Discussion of Morgan Brook's paper.

Wood

The "Grain" of Wood With Special Reference to the Direction to the Fibres (88113). Arhtur Koehler. Ills. 2500 w. A A Wkly—Aug. 12, 1918. Matters of importance in selecting wood for aeroplane construction.

AUTOMOBILES

Axles

Possibilities for Standardization in Tractor Front Axles (88263). Ills. 700 w. Auto Ind—Aug. 15, 1918. Present variety of type could be replaced by a few standard designs which would meet all requirements.

Engines

Buda Model "H T U" Engine (88269). Ills. 1400 w. Auto Ind—Aug. 15, 1918. Designed for truck and tractor service. Detailed description.

Possibilities of the Hvid Engine (88047 B). E. B. Blakely, with discussion. Ills. 8 pp. S A E, Jl—Aug., 1918. Operation, trials, etc.

Exhaust Headers

Exhaust Headers and Mufflers (87817). Archibald Black. Ills. 3000 w. Auto Ind—July 25, 1918. An S. A. E. paper considering the subject from the standpoint of aircraft engineering. Present practice reviewed and conclusions.

Garage

New York's Model Post Office Garage Can Accommodate 200 Mail Truks (88060 A). Ills. 2000 w. Com Vhle—Aug. 1, 1918. Serial, 1st part. Provides all facilities for the maintenance of the 155 trucks in use.

Lubrication

Grease vs. Oil for Chassis Lubrication (87079). Ills. 1500 w. Auto Ind—Aug. 1, 1918. Opinions differ as to the advantages of each.

Magnetos

Non-Distributor and Multipolar Magnetos (88094). Fred I. Hoffman. Ills. 1400 w. Auto Ind—Aug. 8, 1918. Practical possibilities of magnetos designed for use with separate distributors in the engine camshaft.

Motor Transport

Motor Transport Corps Under Brig.-Gen. Drake (88332). Allen Sinsheimer. 2800 w. Auto Ind—Aug. 22, 1918. New corps will control all motor apparatus except ambulances, tanks and tractors.

Motor Trucks

Need of Motor Truck Makers for Materials and Fuel (87815). 3000 w. Auto Ind—July 25, 1918. Text of presentation before the War Industries Board.

Specifications of Light U. S. Army Truck (88049 B). 3500 w. S A E, Jl—Aug., 1918.

Tractor Engines

Doman Tractor Engines (87081). Ills. 1000 w. Auto Ind—Aug. 1, 1918. Made in three 4-cylinder models.

Tractors

Comments on Some Tractor Problems (88333). Ills. 900 w. Auto Ind—Aug. 22, 1918. New tendencies in design.

Provision of Adequate Housing Facilities. Big Tractor Problem (88093). David Beecroft. 2200 w. Auto Ind—Aug. 8, 1918. Care of machines important as a conservation measure.

Steering Creeper and Two-Wheeled Tractors (88265). A. C. Woodbury. 2000 w. Auto Ind—Aug. 15, 1918. Outlines various plans for steering tractors by other methods than that involved in the Ackerman steering axle.

COMBUSTION MOTORS

Diesel Engines

Elements of Diesel Engine Design (88048 B). W. G. G. Godron. Ills. 3 pp. S A E, Jl—Aug., 1918. The principle of operation.

Gas Engines

Gas-Engine Work on the Pacific Coast (88324 A). Frank A. Stanley. Ills. 2500 w. Am Mach—Aug. 22, 1918. Boring, milling, turning, etc.

Oil Engines

Buckeye-Barrett Oil Engines (88120). Ills. 1500 w. Power—Aug. 13, 1918. A heavy-duty horizontal two-stroke-cycle, semi-Diesel engine using a crosshead for operating on low-grade fuel oils.

Rational Design for an Oil Engine (87828 A). John F. Wentworth. Read before Soc. Nav. Archts. & Mar. Engrs. Ills. 10800 w. Mar Rev—Aug., 1918. Low compression pressures advocated and steam recommended for starting.

Producer Gas

Producer Gas, Its Manufacture and Use (88370 B). C. S. Palmer, with discussion. 33 pp. Engrs Soc W Penn, Pro—May, 1918. History of development.

HEATING AND COOLING

Ammonia

The Solubility of Ammonia (88002 A). M. J. Eichhorn. Tables & Diagrams. 4500 w. Ice & Refrig—Aug., 1918. Former researches and existing data.

Coal Waste

Heat Leakage Wastes Coal (88445 A). Austen Bolam. 1000 w. Ind Man—Sept., 1918. Losses from poorly insulated steam pipes shown.

Comfort Tests

A Study of Degrees of Discomfort (88219). Chart. 1000 w. Ht & Vt Mag—Aug., 1918. Based on temperature comfort tests made at the Chicago Normal College by Prof. J. W. Shepherd.

Cost Study

Meeting the High Cost of Heating and Ventilating Apparatus (88221). George T. Mott. Ills. 3000 w. Ht & Vt Mag—Aug., 1918. Discussion based on an article advocating the use of pipe coils as an economy measure.

Development in Heating and Ventilation During the Past Five Decades (88220). Werner Nygren, in *Record and Guide*. 2200 w. Ht & Vt Mag—Aug., 1918. Review of advances.

Equipment

Heating and Ventilating Equipment as Realty Fixtures (88222). Arthur L. H. Street. 2000 w. Ht & Vt Mag—Aug., 1918. Summary of Court decisions on the removable character of such appliances as against adverse claimants.

Ice Making

Treatment of Water for Raw Water Ice Making (88292 B). M. F. Newman, with discussion. 13 pp. A S R E, Jl—May, 1918. Essentials of water purification.

Refrigeration

Cold Accumulators and Their Application to the Refrigerating Industry (88293 B). Ernst S. H. Baars. Ills. 8 pp. A S R E, Jl—May, 1918. Describes hold-over tanks for keeping the low temperature from the time the refrigerating plant is shut down until it is started again.

The Practical Side of the Low Temperature Compression System (88294 B). H. Sloan, with discussion. Ills. 12 pp. A S R E, Jl—May, 1918. Details of successful installations.

Schools

School Building Heating and Ventilation (88223). Samuel R. Lewis. Ills. 2500 w. Ht & Vt Mag—Aug., 1918. Describes systems and arrangements recently used.

Steam Heating

Dripping One-Pipe Steam-Heating Systems (88062). Albert L. Baum. Ills. 1200 w. Power—Aug. 6, 1918. Measures that will tend to obviate all forms of noises and render quick heating an easy matter.

Temperatures

Temperatures and Their Duration During the Heating Season (87964 A). Reginald Pelham Bolton. 1000 w. A S M E, Jl—Aug., 1918. A study of the effect of low temperatures upon installations of apparatus for heating buildings.

Tunnels

Ventilation of Woodhead Tunnel, Great Central Railway (87922). James B. Ball. Ills. 1000 w. Eng & Con—July 31, 1918. English tunnels between Manchester and Sheffield on the Great Central Ry. Conditions and remedies.

Workshops

Heating and Ventilation of Workshops (87939 A). Ills. 1200 w. Engr—July 5, 1918. Arrangement of a low-pressure hot-water system with reinforced circulation.

Steam-Heating of Workshops (88028 A). 2000 w. Mech Wld—May 17, 1918. The principal factors involved.

HYDRAULIC MACHINERY

Pumping Engines

See same heading under MINING AN METALLURGY, *Mine Operation*.

MACHINE ELEMENTS AND DESIGN

Bearings

Ball Bearings for Machine Shop Equipment—I (87875 A). Edward K. Hammond. Ills. 7000 w. Machy—Aug., 1918. Serial, 1st part. Basic principles to be observed in the design of mountings for ball bearings and methods of lubricating.

Bronze Turntable and Movable Bridge Discs (88022). O. E. Selby. 4000 w. Fndry—Aug., 1918. Discusses specifications and changes recommended.

Cams

Cam Profiles (88391 A). William Ker Wilson. Ills. 1000 w. Mech Wld—July 26, 1918. Serial, 1st part. Investigates the effect which a modification of cam profile can produce upon the inertia pressure to which valve gear is subject.

Screw Threads

Progress Report of Committee on Limits and Tolerances in Screw Thread Fits (87961 A). Ills. & Tables. 6000 w. A S M E Jl—Aug., 1918. Methods of investigation and recommendations.

Screw Thread Situation in Great Britain and America (88041 B). E. H. Ehrman. Charts. 10 pp. S A E, Jl—Aug., 1918. Reviews the early history of screw threads with Sellers and Whitworth profits, discussing details, etc.

Steam Plants

Steam Plant Design (88415). 1800 w. Times Engng Sup—July, 1918. Abstract of paper before British Electrical Engineers on higher pressures and superheat.

MACHINE WORKS AND FOUNDRIES

Bending Machine

Essentials of Bulldozer Operations—The V-Blocks (87926 A). J. V. Hunter. Ills. 4000 w. Am Mach—Aug. 1, 1918. Various classes of work that may be done on a bulldozer, showing the construction of V-blocks of different styles.

Bolts

Bolt Manufacture in Railway Shops (88014 A). M. H. Williams. Ills. 6000 w. Ry Mech Engr—Aug., 1918. Methods and tools necessary for the rapid production of bolts in railway shops.

Core Boxes

Exceptional Gang Core Boxes (88468 A). J. V. Hunter. Ills. 2000 w. Am Mach—Aug. 29, 1918. Methods applicable where large numbers of small duplicate cores are being produced.

Cupola Firing

Advantages Offered By the Oil-Fired Cupola (88024). W. S. Dickson. Ills. 900 w. Fndry—Aug., 1918. Crude oil is sprayed directly onto the coke bed.

Drilling

A Corner Drilling Attachment (88389 A). Ills. 700 w. Mech Wld—July 26, 1918. An attachment for use in confined spaces.

Drilling Machines

Special Shell Drilling Machines (87880 A). Donald A. Baker. Ills. 800 w. Machy—Aug., 1918. Machines and jigs used in drilling fuse socket of shrapnel shells.

Unusual Operations on Drilling Machines (87874 A). Edward K. Hammond. Ills. 1500 w. Machy—Aug., 1918. Use for milling, broaching, driving studs, and assembling.

Essington

Modern Plant Will Make Turbines (87820 A). Ills. 1800 w. Mar Rev—Aug., 1918. Equipment of new Essington works for maximum production of ship propelling machinery.

Forging

Machine Forging in Automotive Plants (88337). Ills. 2000 w. Auto Ind—Aug. 22, 1918. Methods employed; absence of waste of materials and elimination of machining.

Foundry Losses

How the Engineer Stops Foundry Losses (88444 A). S. B. Phelps. Ills. 2000 w. Ind Man—Sept., 1918. Defective castings reduced in number by attention to design.

Foundry Practice

Making a Pattern For a Gas Engine Cylinder (88025). Frank B. Raebig. Ills. 2200 w. Fndry—Aug., 1918. Describes also the construction of the core boxes and two methods of molding.

Furnaces

A Rocking Electric Brass Furnace (88304). H. W. Gillett and A. E. Rhoads. Ills. 3000 w. Br Wld—Aug., 1918. Serial, 1st part. Electric brass furnaces in commercial use, furnaces under experimental test, with details of type named.

Galvanizing

Modern Practice in Galvanizing Sheets (88308 A). Clement F. Poppleton. Ills. 3000 w. Iron Age—Aug. 22, 1918. Serial, 1st part. Methods of constructing and operating galvanizing pots; preparation of material, and costs realized.

Gears

A Note on Spiral Gears (88390 A). Ills. 1200 w. Mech Wld—July 26, 1918. Has special reference to engine gears, where the gear ratio is two to one in most gas engines, and equal ratio in case of steam engines.

Patternmaking and Molding Cast Tooth Gears (88023). Jabez Nall. Ills. 2200 w. Fndry—Aug., 1918. Past and present practices discussing a gear-molding machine.

Grinding

Grinding 6-In. Shell-Boring Cutters (87928 A). George M. Dick. Ills. 500 w. Am Mach—Aug. 1, 1918. Describes a grinding fixture.

Grinding Wheels

The Economical Foundry Use of Grinding Wheels (88021). W. T. Montague. Ills. 5500 w. Fndry—Aug., 1918. What wheels to use and how they should be operated.

Guns

Development of Gun Manufacture (88045 B). W. H. W. Skerrett, with discussion. Ills. 11 pp. S A E, Jl—Aug., 1918. Reviews development and discusses some recent problems in ordnance work.

La Fabrication Des Canons (88430 B). Ch. Dantin. Ills. 5600 w. Génie Civil—July 20, 1918. Fabrication of large guns in French munition works.

The British 6-In. Howitzer (88075 A). I. William Chubb. Ills. 6000 w. Am Mach—Aug. 8, 1918. Serial, 1st part. Gun-making in British shops.

The 75-Mm. Field Gun, Model 1916, M. III. (88322 A). Ills. 5000 w. Am Mach—Aug. 22, 1918. Details of the latest of the four types built by the U. S. Government.

The Three-Inch Anti-Aircraft Gun Model 1918 (87924 A). Ills. 4500 w. Am Mach—Aug. 1, 1918. Detailed description of model being used by this country.

Laboratory

Equipping a Shop Laboratory (87873 A). Ills. 2500 w. Machy—Aug., 1918. Arrangement and brief explanation of methods used in the analysis of iron and steel.

Testing Laboratory at the Fiat Works (87891 A). Ills. 900 w. Engr—June 28, 1918. Arrangements for testing both raw and finished material, at Turin, Italy.

Machine Building

The Rising Cost of Machine Building (87929 A). Ludwig W. Schmidt. 2500 w. Am Mach—Aug. 1, 1918. Labor an important factor; values of material; factory cost.

Machine Tools

Demand for Machine Tools After the War (88232 A). Ludwig W. Schmidt. 2500 w. Am Mach—Aug. 15, 1918. Discusses conditions which will effect business after the war.

Machining

Machining an Automobile Differential Cross (87881 A). Albert A. Dowd. Ills. 1700 w. Machy—Aug., 1918. Sequence of operations.

Molding

Why the Inclined Mold is a Fallacy (88018). R. R. Clarke. 1800 w. Fndry—Aug., 1918. Explains results of mold-inclining, showing its fallacy.

Patterns

Checking Patterns (88027 A). Joseph Horner. 1500 w. Mech Wld—May 17, 1918. Directions.

Pneumatic Tools

Pneumatic Hand-Tools (88029 A). C. Temple Orme. Abstract of paper before Jun. Instn. Engrs. 1500 w. Mech Wld—May 17, 1918. Deals particularly with pneumatic hammers.

Portable Machines

Taking Machines to the Work (87871 A). Edward K. Hammond. Ills. 5000 w. Machy—Aug., 1918. Methods used in applying portable machines in ship operations and the advantages secured.

Preheating

New Departure in Preheating (87843 A). J. B. Diehl. 2000 w. Weld Engr—July, 1918. Value and efficiency of the Wilderwax preheater.

Sand Blast

What the Sand Blast Means to the Foundryman (88020). H. L. Wadsworth. 2200 w. Fndry—Aug., 1918. Types of machines are discussed and their utility and value.

Shell Factory

The Cunard National Shell Factory (87895 A). Ills. & Plates. 3500 w. Engng—July 5, 1918. Serial, 1st part. Detailed description of a factory converted to war service.

Shells

How Dummy Iron Shells Are Molded and Cast (88017). H. Cole Estep. Ills. 2000 w. Fndry—Aug., 1918. A two-part flask is employed and most of the mold is in the cope.

Special Machine-Tool Fixtures for Making the British 18-Lb. Shell (88472 A). Chester B. Hamilton, Jr. Ills. 1000 w. Am Mach—Aug. 29, 1918. Adopting old machine tools for shell manufacture.

Substitutes for Steel for High Explosive Shells (88192 N). W. G. Dauncey. 1000 w. Can Min Inst, Bul—Aug., 1918. Considers the question of substituting other metals.

Shop Practice

A Western Railroad Repair Shop (88078 A). Frank A. Stanley. Ills. 1500 w. Am Mach—Aug. 8, 1918. Methods of aligning cross-head guides, renewing driving boxes, etc., in Reno, Nev., shops.

Manufacturing the Johnson Friction Clutch (88080 A). Ills. 1500 w. Am Mach—Aug. 8, 1918. Methods and processes described.

To avoid error, please order by title and number only.

Sheet-Metal Work (88077 A). E. Andrews. 2500 w. Am Mach—Aug. [illegible] 1918. Suggestions in regard to the increasing use of sheet metal.

Using a Punch Press in Lieu of Bending Rolls (88076 A). J. V. Hunter. Ills. 1500 w. Am Mach—Aug. 8, 1918. Shows how difficult jobs in bending and forming sheet metal may be handled on a punch press by means of wooden dies.

Smiths

The [illegible] Smithy (8858[illegible] A). Joseph Horner. 1500 w. Mech Wld—June [illegible], 1918. Serial, 1st part. A view of advance made in this practice.

Tool Works

Elimination of Chatter Marks From Machined Work (88325 A). Ills. 4000 w. Am Mach—Aug. 22, 1918. Steps that will eliminate this difficulty.

Trademarks

Methods of Trademarking Your Product (87879 A). Edward K Hammond. Ills. 6500 w. Machy—Aug., 1918. Functions of trademarks and how to apply those of the maximum value.

Welded Pipe

The Manufacture of Welded Pipe (88228 A). S. A. Hand. Ills. 1500 w. Am Mach—Aug. 15, 1918. Some methods used in the plant of the National Tube Co., McKeesport, Penn.

Welding

Oxy-Acetylene Welding (87838 B). George B. Malone. 8 pp. Prof Mem—July-Aug., 1918. Properties of oxygen, and of acetylene, etc.

The Manufacture of Oxygen and Its Use for Welding and Metal-Cutting (87923). J. M. Christie. 1000 w. Eng & Con—July 31, 1918. From Pro. Instn of Mech Engrs. (Eng.) The mechanical production of oxygen and its uses.

Unusual Tension Welding (87842 A). Ills. 700 w. Weld Engr—July, 1918. Details of work at a Chicago shop.

Welding Propellers in Panama Canal Foundry (88019). John M. Moffett. Ills. 1200 w. Fndry—Aug., 1918. How blades are repaired by burning-on, with a comparison of costs.

MATERIALS OF CONSTRUCTION

Babbitt

Notes on Babbitt and Babbitted Bearings (88213 D). Jesse L. Jones. Ills. 7 pp. A I M E, Bul—Aug., 1918. Experiments carried out in the chemical laboratory of the Westinghouse Electric and Manufacturing Co., Pittsburgh, Pa.

Glass

The Glass Industry as Affected by the War (88450 N). 140 pp. U S Tariff Com—No. 5. A survey of certain aspects of the glass industry with special reference to war changes.

The Manufacture of Optical Glass (88466 A). S. A. Hand. Ills. 2500 w. Am Mach—Aug. [illegible] its manufacture have been solved and the production undertaken in United States.

Glue

Another Grumble About Glue (88362). Dr. W. R. Drushel. 1800 w. A A Wkly—Aug. 26, 1918. Glues for aircraft work are discussed.

Optical Instruments

[illegible] Classification, properties, testing, etc.

Salvage

Salvage at the Winchester Plant (88441 A). Charles M. Horton. Ills. 2500 w. Ind Man—Sept., 1918. How scrap and waste material is reclaimed and utilized at a munition-making plant.

Tool Steels

Tool Steels (883[illegible]) [illegible] Fndman—Aug., 1918. Outlines the cause of hardening and effect of tempering on carbon steels.

Wood

[illegible]

MEASUREMENT

Air Compressors

Testing Air Compressors (87896 A). A. S. Tennant. Ills. 2000 w. Engng—July 5, 1918. Some test results of a 4,000-cu. ft. Belliss and Morcom air-compressor.

CO. Recorders

CO2 Recorders in the Boiler-House (88286 A). John B. C. Kershaw. Ills. 3500 w. Engr—July 19, 1918. Serial, 1st part. Detailed description of automatic gas-testing apparatus for recording CO2 percentages.

Drills

Efficiency Tests of Rock-Drill Accessory Equipment (88281 A). Charles F. Willis. Ills. 4500 w. Eng & Min Jl—Aug. 17, 1918. Conclusions from tests made with a stopper-type machine drill and Paynter testing apparatus.

Gages

Flush-Pin Versus Limit Gages (88227 A). Albert H. Dowd. Ills. 1000 w. Am Mach—Aug. 15, 1918. Types are described and examples given.

Indicating Fixtures for the Gaging of Automobile Parts (88231 A). Albert A. Dowd. Ills. 2200 w. Am Mach—Aug. 15, 1918. Details of special gaging fixtures used.

Gears

Measuring Gears by the Use of Wires (88230 A). William S. Hudson. Ills. 900 w. Am Mach—Aug. 15, 1918. Explains principles involved.

Strength of Spiral-Type Bevel Gears (87877 A). Reginald Trautschold. Ills. 3500 w. Machy—Aug., 1918. Formulas for determining strength of spiral-type bevel gears and principles upon which they depend.

Heat Meters

Les Compteurs Calorimétriques (88426 B). R. Joessel. Ills. 2600 w. Génie Civil—July 6, 1918. Serial, 1st part. Development of meters for steam and hot water.

Joints

Simplification of Riveted Joint Design (88369 B). H. A. S. Howarth, with discussion. 52 pp. Engrs' Soc W Penn, Pro—May, 1918. A study of the method of calculating joint efficiencies published in the Report of the Boiler Code Committee of the A. S. M. E.

Lubricants

The Testing of Lubricants (88229 A). Raymond Francis Yates. Ills. 1500 w. Am Mach—Aug. 15, 1918. Simple tests for lubricating oils and greases.

Pyrometers

The Types and Industrial Uses of Pyrometers (88302). Ills. 3500 w. Can Fndman—Aug., 1918. Illustrated detailed description of types and their uses.

Springs

Strength of Helical Springs (88026 A). W. A. Atkinson. Table. 500 w. Mech Wld—May 17, 1918. Useful table giving ready worked-out loads and deflections.

Stresses

Stresses in Curved Pipes (88172 A). J. S. Henzell. 1500 w. Mech Wld—July 5, 1918. Serial, 1st part. First article considers inferences which are to be considered in curved pipes which suffer no external restraint.

First Principles of Stresses (88165 N). W. Workman. Ills. 2500 w. Per-Way Instn, Jl—April, 1918. Deals principally with sling chains and their limits of safety.

Time Charts

Charts Giving Time Required to Hob Spur Gears (87872 A). V. P. Rumely. Charts. 600 w. Machy—Aug., 1918.

POWER AND TRANSMISSION

Belting

Belting Problems Discussed at Chicago Meeting (88036). 5500 w. Elec Rev, Chi—Aug. 3, 1918. Discussion of belting and its use.

Elevators

Factors Governing Elevator Drive (88352). C. E. Clewell. Ills. 2500 w. Elec Wld—Aug. 24, 1918. Standard safety features; power requirements, and types of motors suited to service.

Garabed Motor

Why of the Garabed Motor "Mystery"? (88465 A). 800 w. Ind Man—Sept., 1918. Editorial on Garabed T. K. Giragossian's mistaken idea.

Hospital Plant

Cook County Hospital Power Plant (87830). Thomas G. Thurston. Ills. 3000 w. Natl Engr—Aug., 1918. Coal saving and improved service by new installation.

Service for the Sick (87846). Ills. 2500 w. Pwr Pt Eng—Aug. 1, 1918. Details of modern power plant at Blodgett Memorial Hospital, Grand Rapids, Mich.

Lubrication

Lubrication of Air Compressors (87950). W. H. Callan. 2500 w. Cl Age—Aug. 1, 1918. Discusses air cylinder lubrication.

Lubrication of Air-Compressor Cylinders (88119). W. H. Callan. 2000 w. Power—Aug. 13, 1918. Résumé of experience showing that a light mineral oil, and little of it, is best lubricant.

Power Plants

Practical Operation of a Producer-Gas Power Plant (88137 N). Francisco R. Ycasiano and Felix V. Valencia. Ills. 32 pp. Phil Jl Sci—May, 1918. Describes the suction producer-gas plant in the power house of the Bureau of Science, and the trial of Philippine fuels.

The Massachusetts Plan of Power-Plant Inspection and Coal Conservation (88452). Thomas Hawley. 2500 w. Power—Aug. 27, 1918. Outlines plan of inspecting and classifying power plants.

"Gasteam" Plant at Ford City, Ontario (88061). Ills. 3500 w. Power—Aug. 6, 1918. A combination alternating and direct-current plant employing "Gasteam" engines.

Water Power

Water Power (88412). 2000 w. Times Engng Supp—July, 1918. Its development in different parts of the British Empire.

Canada's Water Powers: Their Relation to the Fuel Situation (87814). J. B. Challies. Ills. 1200 w. Pr House—July, 1918. Shows the need of a national fuel-power policy for the development and use of the fuel resources of the Dominion.

STEAM ENGINEERING

Boiler House

The Maintenance of Economy in the Boiler House (87909 A). D. Wilson. 4000 w. Elec'n—June 28, 1918. Importance of keeping records of performance; sampling and testing of coal, etc.

Coal Storage

Storing Coal in a Small Plant (87820). Ills. 1500 w. Elec Wld—July 27, 1918. A flexible system of portable conveyors is tied in with modern coal-handling equipment.

Condensers

Recent Developments in Condensers (87987). D. W. R. Morgan. Ills. 2000 w. Elec Wld—Aug. 3, 1918. Relative advantages of steam air ejectors and hydraulic and reciprocating air pumps.

Condensers

Steam Condensers (87832). J. H. Coates. 4500 w. Natl Engr—Aug., 1918. The two general types and their applications.

Condenser Tubes

A Short Note on a New Method of Cleaning Condenser Tubes (88255 N). T. G. Otley. 1200 w. So Af Instn Engrs, Jl—June, 1918. Involves the use of discs cut out of scrap rubber.

What Is the Cure for Condenser Tube Corrosion? (88274). Hartley Le H. Smith. 3000 w. Elec Ry Jl—Aug. 17, 1918. Proper selection of material and care in manufacture secure longer life of tubes.

Condensing

The Problem of Condensing in Large Power Stations (87910 A). J. H. Rider. 3500 w. Elec'n—June 28, 1918. Large quantities of condensing water necessary and methods which may be used when the flow of water on a river site is insufficient.

Cooling Systems

Cooling of Condensing Water by Towers and Spraying (88145 N). E. W. Marriott. 1800 w. Comwh Engr—July, 1918. Abstract of paper before Engng. Assn. of N. S. W. The two plants are described and the amount of cooling given.

Engine Economy

Improving Engine Economy (87847). M. A. Saller. Ills. 3800 w. Pwr Pt Eng—Aug. 1, 1918. Increasing the capacity and improving the efficiency of steam engines by proper valve setting, eliminating leakage and maintaining speed regulation.

Fuels

Firing Crude Oil (88262). J. W. Eshnaur. Ills. 1000 w. Pwr Pt Eng—Aug. 15, 1918. Types of burners, furnaces and methods of regulation.

Sawdust and Wood Burning (88261). Ills. 5000 w. Pwr Pt Eng—Aug. 15, 1918. A symposium dealing with furnace designs, conditions to maintain, conveying and storage systems, etc.

Fuel Saving

Fuel Conservation (87831). Charles W. Naylor. 2500 w. Natl Engr—Aug., 1918. Data on easily accomplished fuel saving.

Conservation of Fuel in California (88354). R. J. C. Wood. Map. 2500 w. Elec Wld—Aug. 24, 1918. Savings of fuel oil made by interconnection of systems.

Furnaces

Boiler Furnaces and Boiler-Furnace Design (88454). D. S. Jacobus. 4000 w. Power—Aug. 27, 1918. Address before the Am. Boiler Mfrs.' Assn., at Philadelphia, June 17, 1918.

Gas

Gas For Raising Steam (88414). 2000 w. Times Engng Supp—July, 1918. Recent developments in use of gas for raising steam.

Powdered Coal

Control of Combustible and Air in Burning Powdered Coal (88185). W. G. Wilcox. From paper before Am. Chem. Soc. 2000 w. Com Air Mag—Aug., 1918. Its value as a fuel and the conditions for success.

Power

Development of Power from the Standpoint of the Boiler Room (88299). C. F. Hirshfeld. 2500 w. Power—Aug. 20, 1918. J. E. Aldred Lectures on Engineering Practice at Johns Hopkins University. (Abstract.) Suggestions.

Soot Blowers

Soot Blowers for Vertical and Hollow Stay-Bolt. Boilers (88118). Ills. 2500 w. Power—Aug. 13, 1918. Details of various systems. Special makes of blower and a system designed for continuous soot removal.

Soot Removal

Soot Removal From Fire-Tube Boilers (88453). Ills. 1500 w. Power—Aug. 27, 1918. Describes rear-end and front-end blowers and other cleaners.

Starting Torque

Methods of Finding Starting Torque (87866). L. L. Loomer. 700 w. Power—July 30, 1918. Test made on a cross-compound horizontal engine in a rolling-mill.

Steam Economies

Possible Economies by the Use of High-Pressure Steam (87908 A). Frederick Samuelson. Ills. 2800 w. Elec'n—June 28, 1918. Considers improved efficiency obtainable by increasing the temperature and pressure of steam. Particulars of Rugby works of the British Thomson-Houston Co., Ltd.

Turbines

A New Theory of the Steam Turbine (87894 A). Harold Medway Martin. 3500 w. Engng—July 5, 1918. Serial, 1st part. Reasons for believing another great anomaly in steam-turbine engineering may be traced to an error in the theory of the efflux of steam.

Small Steam Turbines (87976 A). J. Humphrey. Ills. 1600 w. Ir & Cl Trds Rev—July 19, 1918. Their increased use, care, etc.

The Forty-Five-Thousand Kilowatt Compound Turbine at Providence, R. I. (88451). J. P. Rigsby. Ills. 2200 w. Power—Aug. 27, 1918. Detailed description of turbine recently started.

Water Softener

International Water Softener (87868). Ills. 1200 w. Power—July 30, 1918. Detailed description of apparatus.

TRANSPORTING AND CONVEYING

Coal Handling

Problems of Coal Handling (87907 A). W. B. Woodhouse. 4500 w. Elec'n—June 28, 1918. Data in regard to the quantities necessary for a station with a load of 100,000 kw. and the ground required for sidings. Types of plant available for handling.

Conveyors

Conveyors for Chemical Works (88183 B). William H. Atherton. Ills. 1700 w. Cas Eng Mthly—July, 1918. Serial, 1st part. Present article deals with devices in use in gas and chemical works.

The Human Conveyor (88184 B). George Frederick Zimmer. Ills. 1200 w. Cas Eng Mthly—July, 1918. Performance of man as a motor when hauling a load, based on experiments conducted by Prof. Max Ringelmann.

Ropeways

Ropeways in War-Time (88388 A). Ills. 1500 w. Mech Wld—June 21, 1918. New and revised forms of ropeways introduced to meet the need.

ELECTRICAL ENGINEERING

COMMUNICATION

Cables

Aerial Cable Construction Kinks (88105). Ills. 1500 w. Telephony—Aug. 10, 1918. New methods and devices developed which facilitated rapid placing of cable.

Radiotelegraphy

Oscillation Valve Detectors for Wireless (88040 A). Dr. J. A. Fleming, in London Times. Ills. 2500 w. Tel Engr—Aug., 1918. Application and properties.

L'État Actuel De La Radiotélégraphie (88432 B). L. Bouthillon. Ills. 5600 w. Génie Civil—Aug. 3, 1918. Serial, 1st part. Present development of radiotelegraphy and its applications.

Ringing Equipment

Central Office Ringing Equipment (88455). P. A. Price. Ills. 3000 w. Telephony—Aug. 24, 1918. Serial, 1st part. Practical explanation of electrical theory of Central Office ringing, and equipment developed.

Telephony

Telephone Exchange Transfers and Their Organization (88385 N). F. G. C. Baldwin, with discussion. Ills. 46 pp. Instn E E, Jl—June, 1918. Operations for actual transfer and engineering processes customarily accompanying the work.

ELECTRO-CHEMISTRY

Chemistry

Germany's Stolen Chemistry (88345). Townes R. Leigh. 2500 w. Mfrs Rec—Aug. 22, 1918. Important scientific discoveries and industrial processes of all nations that have been appropriated by the Germans.

Electric Furnaces

Metallurgical Electric Furnaces (88394 A). Ills. 2500 w. Engng—July 26, 1918. Serial, 1st part. Deals particularly with iron and steel furnaces. Based on a discussion before the Faraday Society.

Electrodes

The Sign of the Zinc Electrode (88305). Wilder D. Bancroft. 2200 w. Br Wld—Aug., 1918. Reviews the positions of German physical chemists as to the sign to be applied to the zinc electrode, and discusses the problem.

Electrolytes

The Role of Complex Salts as Electrolytes in Plating and Refining Baths (88307). Reginald S. Dean and Ming Yi Chang. Ills. 2000 w. Br Wld—Aug., 1918. Theories and experimental study.

Electrometallurgy

Electric Furnace for Melting Alloys (88279). William H. Easton. Ills. 1200 w. Elec Wld—Aug. 17, 1918. Control apparatus must be carefully selected to provide for heavy fluctuations of load.

Electroplating

Electroplating Military Supplies ([illegible]). 2000 w. Can [illegible]—July, 1918. Recommendations.

Electrolytic Process

Electrolytic Oxygen and Hydrogen (88163 N). 9 pp. Trav Stand—July, 1918. Precautions for safety in the manufacture.

Ferro-Alloys

The Manufacture of Ferro-Alloys in the Electric Furnace (88211 D). Robert M. Keeney. 52 pp. A I M E, Bul—Aug., 1918. Metallurgical side of the manufacture.

Nitrate Plants

Remarkable Record Made by Southern at Sheffield, Ala. (87034). Ills. 1000 w. Ry Age—Aug. 2, 1918. Location of 12 government nitrate plants causes the population to treble in ten months.

ELECTRO-PHYSICS

Electromagnets

The Stroke of an Alternating-Current Electromagnet (88381 A). A. Thomälen. Abstract of an article in *Elektro. Zeit.* 1000 w. Elec'n—July 26, 1918. Conditions for an a. c. magnet.

Frequency

Theory of the Static Frequency-Doubler (88377 A). M. Osnos. 1000 w. Elec'n—July 19, 1918. Abstract of an article in Elektro. Zeit. Mathematical.

Harmonics

Higher Harmonies in Polyphase Electric Systems (88379 A). V. Karapetoff. Abstract of paper before Am. Assn. for Adv. Sci. 1500 w. Elec'n—July 19, 1918. Higher harmonics in a symmetrical *m*-phase system are considered for both the star and the mesh connection.

Skin Effect

Skin Effect in Tubular and Flat Conductors (88214 D). H. B. Dwight. 20 pp. A I E E, Pro—Aug., 1918. Method for calculating the skin effect resistance ratio of a tube, and also of a thin strap.

Solenoids

Short-Circuit Windings in Direct-Current Solenoids (87967 A). O. R. Schurig. Ills. 1400 w. Gen Elec Rev—Aug., 1918. Useful applications

GENERATING STATIONS

Hydro-Electric

Construction Problems at Copco Plant (87986). Ills. 1000 w. Elec Wld—Aug. 3, 1918. Hydroelectric installation on the Klamath River, in Oregon. Difficulties due to extensive changes made after the work was started.

Interesting Small-Capacity Low-Head Hydroelectric Development (88035). Ills. 1800 w. Elec Rev, Chi—Aug. 3, 1918. Geddes plant, on Huron River, utilizing low-head water power.

Junction Development Power Plant (88,297). Ills. 3000 w. Power—Aug. 20, 1918. Details of the largest hydro-electric plant in Michigan, connected with Grand Rapids by a 140,000-volt line.

Modern Development of Large Hydro-Electric Power Schemes (87796 A). C. Fred. Holmboe. Ills. 3500 w. Elec'n—June 21, 1918. Outlines the procedure that should be adopted, and gives details.

New Plant Added to Michigan System (88108). Ills. 3500 w. Elec Wld—Aug. 10, 1918. Junction development, the largest hydro-electric plant in Michigan, is model of simplicity. Connected with Grand Rapids by 140,000-volt line.

Power Factor

Effect of Power-Factor on Central Station Operation (88116). Will Brown. Ills. 2500 w. Elec Rev, Chi—Aug. 10, 1918. Good volt regulation and transmission efficiency can be obtained by installing synchronous motors.

Rates

Reasonable Charge for Off-Peak Electric Current (88298). 1500 w. Power—Aug. 20, 1918. Opinion of Percival R. Moses of a reasonable rate for off-peak current furnished by the central station to the isolated plant.

Substation

The New 45th Street Substation of the United Electric Light & Power Co., New York (87945 A). Roy R. Kime. Ills. 2500 w. Elec Jl—Aug., 1918. Layout and operating arrangements, equipment, etc.

Switchgear

Some Considerations Relating to Large Power Station Switchgear (87911 A). H. W. Clothier. Ills. 3500 w. Elec'n—June 28, 1918. Deals with oil switches.

Turbine Plants

Turbine House Plant Operation, with Special Reference to the Rand Power Companies' Plants (88140 N). T. G. Otley and V. Pickles. Ills. 20 pp. So Af Inst Elec Engrs, Trans—May, 1918. Salient points connected with the efficient operation of turbine plant.

GENERATORS AND MOTORS

Asynchronous

La Machine Asynchrone A Bagues (88,404 D). M. Latour. Ills. 4500 w. Bul Société Française Des Électriciens—June, 1918. Current and voltage conditions in asynchronous machines.

D. C. Generator

A Direct-Current Generator for Constant Potential at Variable Speed (88216 D). S. R. Bergman. Ills. 8 pp. A I E E, Pro—Aug., 1918. A new solution of this problem and its advantages.

Generator Sets

The Growth in Size of Generating Sets (88143 N). A. McKinstry. 1500 w. Comwh Engr—July, 1918. Precis of presidential address to Elec. Assn. of Australia. Development.

Induction Motors

Calculation of Performance of Induction Motors Working in Conjunction with Flywheels and Slip Regulators (88378 A). Herbert Vickers. 1200 w. Elec'n—July 19, 1918. Serial, 1st part. Mathematical.

Interpoles

Practical Points Concerning Interpoles (88376 A). Ills. 1000 w. Elec Rev—Aug. 2, 1918. Methods of making the polarity of the interpoles right.

Motor Control

Remote Control for Squirrel-Cage Motors (87915 A). L. E. Wood. Ills. 1500 w. Elec Rev—July 12, 1918. Advantages of a remote-control system. Describes an installation in Canada.

Motor Faults

Electric Motor Faults (88476 A). J. Humphrey. 4000 w. Ir & Cl Trds Rev—Aug. 2, 1918. Troubles and their causes, with suggestions for remedies.

Power Factor

Practical Limitations to Power Factor Correction (88277). Ralph Kelly. 2000 w. Elec Rev, Chi—Aug. 17, 1918. Influence of location of corrective apparatus upon generator and conductor capacity and voltage regulation.

See also same heading under *Generating Stations.*

ILLUMINATION

Fuel Saving

Lighting Curtailment (88127 A). Preston S. Millar, with discussion, references and appendix. Diagrams. 11500 w. E Ch Phila, Jl—Aug., 1918. Considers the subject as a coal-saving measure.

See also same heading under INDUSTRIAL MANAGEMENT, *Regulation.*

Industrial Lighting

Laws Regarding Insufficient Lighting (88469 A). Chesla C. Sherlock. 2500 w. Am Mach—Aug. 29, 1918. Court decisions in cases of damage suits where insufficient lighting has been made the cause.

Light Emission

The Mechanism of Light Emission (88,186 A). E. P. Lewis. 14 pp. Sci M—Aug., 1918. Discusses radiation from the present state of knowledge.

Light Transmission

Transmission of Light Through Water (87971 A). S. L. E. Rose. Ills. 700 w. Gen Elec Rev—Aug., 1918. Investigations.

MEASUREMENT

Alternating Currents

A New Method of Measuring Alternating Currents and Electric Oscillations (88380 A). I. Williams. Abstract of paper before Physical Soc. Ills. 1000 w. Elec'n—July 19, 1918. A new thermal method is proposed and two new types of instruments described.

The Representation of Alternating-Current Quantities by Vectors (87947 A). Alexander D. DuBois. Ills. 3000 w. Elec Jl—Aug., 1918. The substitution of vectors for sine curves.

Meters

Demand Meters (87970 A). J. A. Laubenstein. Ills. 1500 w. Gen Elec Rev—Aug., 1918. Considers the actual measurement of demand and describes types of meters.

POWER APPLICATIONS

Auxiliaries

Motor-Driven Auxiliaries (88331 A). C. Grant. 1500 w. Mech Wld—June 14, 1918. Serial, 1st part. Claims the electric motor fulfills all requirements.

Electric Stops

Water Indicator and Motor Stop (88,330). Frank Huskinson. Ills. 1000 w. Cl Age—Aug 22, 1918. Eliminated the tank overflow by means of electric stops.

Heat Treatment

Electric Furnace for Heat Treating of Small Airplane Parts (88467 A). Dwight D. Miller. 3500 w. Am Mach—Aug. 29, 1918. Methods give very uniform results.

Electric Treatment of Airplane Forgings (88224 A). Dwight D. Miller. Ills. 3000 w. Iron Age—Aug. 15, 1918. Details of the Bailey furnace.

Lime Plant

A Modern Motor-Driven Lime Plant (87944 A). A. E. Truesdell and C. T. Maynard. Ills. 1200 w. Elec Jl—Aug., 1918. Plant of the Vermont Marble Co., near Rutland, Vt.

Paper Mill

Motor Drive in Paper and Pulp Mills (87822). C. E. Clewell. Ills. 1800 w. Elec Wld—July 27, 1918. Serial, 1st part. Important applications; variations in power requirements; examples.

Printing Plants

Application of Printing-Press Motors (88280). C. E. Clewell. Ills. 2500 w. Elec Wld—Aug. 17, 1918. Requirements.

Therapeutics

I. Diathermy: the Use of the Electrical Current to Raise the Temperature of the Body in the Treatment of Disease. E. P. Cumberbatch. II. Single-Impulse Radiography (Instantaneous): Its Limitations and Possibilities. Robert Knox (88383 N). Two papers with discussion. 18 pp. Instn E E, Jl—June, 1918. Problems of the medical profession in the domain of electricity.

Tire-Making

Electricity in the Manufacture of Automobile Tires (87848). B. B. Jackson. Ills. 2000 w. Elec Rev, Chi—July 27, 1918. Serial, 1st part. Process of tire-making; choice of motors and features of control.

Welding

See Electric Welding, under MARINE AND NAVAL ENGINEERING.

Woodworking

Motor Drive for Woodworking Machinery (88109). C. E. Clewell. Ills. 2200 w. Elec Wld—Aug. 10, 1918. Examples of successful motor applications.

TRANSFORMERS

Outdoor Transformers

Outdoor Water-Cooled Transformers (88063). R. von Fabrice. Ills. 1000 w. Power—Aug. 6, 1918. Necessary equipment to properly handle the oil and to furnish a suitable cooling-water supply.

Radiator Type

Radiator Tank Transformers (87966 A). H. O. Stephens and A. Palme. Ills. 1200 w. Gen Elec Rev—Aug., 1918. Describes the construction of some of the latest forms.

TRANSMISSION AND DISTRIBUTION

Cables

The Test Sheath Cable and Its Potentialities (87913 A). Ills. 2000 w. Elec'n —July 5, 1918. Outline of lecture by C. J. Beaver at Trafford Park.

Condensers

Static Condensers (87969 A). W. B. Taylor. Ills. 2000 w. Gen Elec Rev—Aug., 1918. Shows the improvement in service that may be effected by use of static condensers on circuits of low power-factor.

Conductors

Characteristics of Iron and Steel Conductors (87821). Charles E. Oakes and P. A. B. Sahm. 1200 w. Elec Wld—July 27, 1918. Serial, 1st part. Use stimulated by war emergencies. Test data for calculating electrical characteristics.

Earthing

Earthing Electrical Services in Mines (87902 A). 2500 w. Colly Gdn—July 12, 1918. Care needed for safety; the ideal earth.

Induction

Inductive Effects of Alternating Current Railroads on Communication Circuits (88217 D). H. S. Warren. 30 pp. A I E E, Pro—Aug., 1918. Inductive interference in general and that due to electrified railroads, and means of preventing the trouble.

Interconnection

New England Interconnection Plan Takes Shape (88110). Map and plans. 2000 w. Elec Wld—Aug. 10, 1918. Serial, 1st part. Deals particularly with southeastern Massachusetts. Propose duplicate line from Boston to Fall River.

Iron Lines

Resistance and Reactance of Iron Transmission Lines (88382 A). A. Press. 1800 w. Elec'n—July 26, 1918. A new mathematical operator method.

Line Sag

Sag Calculation for Iron-Wire Lines (87985). M. D. Leslie. 1500 w. Elec Wld—Aug. 3, 1918. Suggests stringing lines with less sag as a war-economy, when conditions warrant.

Losses

Economy in Electrical Distribution (88,-278). W. B. Stetzner. 2500 w. Elec Wld—Aug. 17, 1918. Investigation of losses for the purpose of improving the service at minimum expense.

Power Transmission

The Transmission of Power (87912 A). B. Welbourn. 6000 w. Elec'n—June 28, 1918. Considerations which must affect the choice between underground cables or overhead lines. Gives costs of five schemes.

Reactance

Reactance and Short-circuit Current (87968 A). R. E. Doherty. Ills. 800 w. Gen Elec Rev—Aug., 1918. Explains the inter-relationship.

MISCELLANY

Electrical Campaign

California's Electrical Coöperative Campaign (87823). S. M. Kennedy. 3000 w. Elec Wld—July 27, 1918. Outlines the first year's activities for the purpose of developing maximum intelligent distribution of electrical goods.

Electrical Industry

A Review and Forecast of the Electrical Industry (87965 A). E. W. Rice, Jr. Presidential address at Atlantic City, June, 1918. 4500 w. Gen Elec Rev—Aug., 1918. Phases of the industry which are of special significance.

Electrical Trades

The Electrical Trades After the War (87893 A). 4500 w. Engr—June 28, 1918. Excerpts from the report of a departmental committee appointed by the Board of Trade.

Progress

A Review of Electrical Engineering Progress (88215 D). E. W. Rice, Jr. President's address. 12 pp. A I E E, Pro—Aug., 1918. Matters of present interest and importance. Methods and devices adopted for improving efficiency and economy.

CIVIL ENGINEERING

BRIDGES

Concrete Trestles

Reinforced Concrete Trestles at North Toronto (88248). Ills. 1500 w. Ry Age—Aug. 16, 1918. Details developed in viaducts designed as a substitute for steel construction.

Pier-Foundations

Method of Extending Pier-Foundations of the Wanganui Bridge (87920). Robert W. Holmes. Ills. 1000 w. Eng & Con—July 31, 1918. Details of work in New Zealand.

Rebuilding

Rebuilding the C. B. & Q. R. R. Bridge Over the Platte River, Near Grand Island, Neb. (87844). Ills. 900 w. Ry Rev—July 27, 1918. Interesting features of the work.

Bethlehem Ore Bridge Built in 65 Days (88309 A). Ills. 700 w. Iron Age —Aug. 22, 1918. Rapid reconstruction of structures of the Bethlehem Steel Co., replacing two destroyed by a violent storm.

River Crossings

River Crossings (87839 B). Ills. 34 pp. Prof Mem—July-Aug., 1918. Extracts from "Tactics and Technique of River Crossings," by General Mertens (German Army).

Russia

Bridge Across the River Vistula at Warsaw (88300 A). Ills. 800 w. Engr —July 26, 1918. Brief description of a recently completed bridge at the capital of Russian Poland. Built on the three-pointed arch system.

Viaducts

Design and Construction Features of Concrete Viaduct Approach to Central Ave. Bridge, Kansas City, Kan. (87797). Ills. 1200 w. Eng & Con—July 24, 1918. Artistic concrete design.

The Langwies Reinforced Concrete Viaduct (87917). Ills. 500 w. Eng & Con—July 31, 1918. Arch of 96 meters clear span between abutments, in Switzerland. Interesting arch-centering.

Wilson Bridge

Le Pont Wilson, A Lyon (88427 B). A. Dumas. 5700 w. Génie Civil—July 13, 1918. New arch bridge over the Rhone, at Lyons, France.

CONSTRUCTION

Buildings

Army Supply Depot at Chicago Is Large Concrete Warehouse (88085 A). A. Epstein. Ills. 1500 w. Eng News-Rec—Aug. 8, 1918. One of the largest reinforced-concrete buildings in the world nearing completion, to be used as a storage warehouse for the army.

Buildings

The Army Libraries and Liberty Theatres (87997 B). Alfred Morton Githens. Ills. 1700 w. Arch For—July, 1918. Description of buildings, cost, requirements, etc.

Caissons

Concrete Caisson of New Type Used in Breakwater (88081 A). Ills. 1200 w. Eng News-Rec—Aug. 8, 1918. Trapezoidal shape adopted for economy.

Canteens

Canteen Construction and Equipment (88178 B). Ills. 14 pp. Cas Eng Mthly —July, 1918. Serial, 1st part. Principles of canteen construction and the most beneficial equipment.

Cement Gun

Cement-Gun Construction Methods (88065). Bryan Cheves Collier. Ills. 2000 w. Can Engr—July 12, 1918. Reviews application of gunite to wall construction and similar work.

Chimneys

Tall Chimneys in Metallurgical Plants (87863 A). Ills. 2000 w. Eng & Min Jl —July 27, 1918. Some of the notable chimneys in use at metallurgical plants in the United States and Japan.

Concrete

Concrete Foundations, Drift Linings and Reservoirs (87949). J. F. Springer. Ills. 4800 w. Cl Age—Aug. 1, 1918. Directions for the use of concrete in work named.

Concrete Beams

Long-Span Concrete Beams Should Have Fixed Ends (88319 A). W. S. Tait. Ills. 1000 w. Eng News-Rec—Aug. 22, 1918. Method by which computation of rigid frame design may be readily made.

Placing 52-Ton Pre-Cast Beams on North Toronto Bridges of C. P. Ry. (87800). Ills. 1000 w. Eng & Con—July 24, 1918. Describes work at North Toronto, where two single-track steel bridges were replaced by reinforced concrete structures.

To avoid error, please order by title and number only.

Concrete Piles

Les Pieux En Béton Armé (88425 B). A. Bijls. 3400 w. Génie Civil—July 6, 1918. Reports on use of concrete piles in the Low Countries.

Contract Records

Visible Record System for Expediting Construction Contracts (87799). 1000 w. Eng & Con—July 24, 1918. System employed by the Public Works Office of the Philadelphia Navy Yard, as described by DeWitt C. Webb.

Coördination

Coordination Saves Six Weeks' Construction Time on Big Building (88243 A). Ills. 2500 w. Eng News-Rec—Aug. 15, 1918. Duplicate equipment eliminates delays; promoting esprit de corps among men is important feature.

Fireproof

Modern Fire Proof Buildings (88162 X). Charles H. Nichols. Ills. 16 pp. Vt Soc Engrs, Pro—March 13, 1918. Reviews development and construction.

Fortifications

The Influence of the European War Upon the Art of Field Fortifications. (88368 B). F. B. Wilby. Ills. 65 pp. Prof Mem—July-Aug., 1917. Lessons from experience in the European war.

Foundations

Boiler House as Stack Foundation (87865). L. C. Huff. Ills. 1500 w. Power—July 30, 1918. Four-story steel and concrete building used as foundation for large steel stack.

Framing Plan

Framing Plans Simplify Fieldwork on Cincinnati High School (88318 A). John T. Sullivan. Ills. 1800 w. Eng News-Rec—Aug. 22, 1918. Single-sheet framing plan gives all data required by form builders and steelworkers.

Military Engineering

The German Shelters on the Somme (88366 B). Ills. 8 pp. Prof Mem—July-Aug., 1917. Detailed description.

Mill Buildings

Wood in the Construction of Mill Buildings (88067). W. Knoch and R. J. Blair. Ills. 2000 w. Can Engr—Aug. 1, 1918. Is it a suitable material?

Quebec

See same heading under Waterways and Harbors.

Safety

The Opportunities for Safety Engineering in Construction Work (88316). David Van Schaack. Abstract of paper before the Conn. Soc. of C. E. 2000 w. Eng & Con—Aug. 21, 1918. Features of accident prevention are considered.

Tunnels

The Use of the Air Hammer Drill in Tunneling Practice (88142 N). Bland Owen. Ills. 4000 w. Comwh Engr—July, 1918. Relat[illegible] types of drill bits.

IRRIGATION AND RECLAMATION

Dams

The 236-ft. Dam of Murrumbidgee Irrigation Project (87919). Ills. 900 w. Eng & [illegible] 1918. [illegible] interesting engineering work in New South Wales.

Drainage

Keeping Land Drainage Channels Clear of Growth and Debris in the South (88083 A). Albert S. Fry. 4000 w. Eng News-Rec—Aug. 8, 1918. Experiences in removing willow and other sprouts and maintaining cross sections in two drainage districts.

Main Drainage Channels for Reclaimed Areas of Southern Louisiana (88195 A). Charles W. Okey. Map. 1500 w. La Eng Soc, Pro—Aug., 1918. States conditions and discusses the problem.

Porous Soils

Border Method of Irrigation for Porous Soils (88234). R. W. Allen. From circular of Oregon Agri. College Ex. Station. 1700 w. Eng & Con—Aug. 4, 1918. Explains method and preparation of land.

Reclamation

Land Reclamation Would Provide Work and Homes for Hosts of Veterans (88320 A). Arthur P. Davis. 3000 w. Eng News-Rec—Aug. 22, 1918. Irrigation and drainage of 20,000,000 acres would care for a million families in agricultural and allied pursuits.

MATERIALS OF CONSTRUCTION

Concrete

Effect of Time of Mixing on the Strength of Concrete (87977). Duff A. Abrams. Ills. 4000 w. Can Engr—July 25, 1918. Serial, 1st part. Tests show that inferior concrete is produced by undermixing but excess of water is the greater evil. Read before Am. Concrete Inst.

Lukewarm Concrete Enough Precaution for Zero Weather Dam Work (88082 A). Ills. 1200 w. Eng News-Rec—Aug. 8, 1918. Perfect bond and sound concrete secured by placing 50° mixture on frozen surfaces.

Notes on the Condition of Some Underground Concrete Work in Winnipeg (88339). Bertram Stuart McKenzie. Ills. 2500 w. Can Engr—Aug. 22, 1918. Read at Saskatoon meeting of Eng. Inst. of Canada. Examples of deterioration.

Oil and Concrete (87882 A). 4500 w. Ry Engr—July, 1918. Serial, 1st part. Conditions under which oil may affect concrete.

Relation of Stone Aggregate Content to the Compressive Strength of Concrete (88338). Llewellyn N. Edwards. 800 w. Can Engr—Aug. 22, 1918. Tests indicate that 20 per cent. of stone reduces strength of mortar by 3 per cent., while 40 per cent. of stone reduces it by 11 per cent.

Some Tests on the Effect of Age and Condition of Storage on the Compressive Strength of Concrete (88147). Harrison F. Gonnerman. 2000 w. Can Engr—Aug. 8, 1918. Read before Am. Concrete Inst.

The Basic Principle of Concrete Mixes and the Truly Fundamental Role Played by Water (87798). Duff A. Abrams. 1500 w. Eng & Con—July 24, 1918. Studies showing the injurious effects of too much water.

Corrugated Culverts

The Use and Abuse of Corrugated Culverts (88160 D). A. F. Rushton. 1500 w. Okla Soc Engrs, Trans—Vol. IV, 1918. Failures due to improper construction or installation.

Rope Splicing

Splicing Wire Rope (88153). Abstract from "Lescheus Hercules." Ills. 800 w. West Eng—Aug., 1918. Tools required and methods described.

Slag

Molten Slag is Hauled by Rail for Making Embankments (88084 A). Ills. 2000 w. Eng News-Rec—Aug. 8, 1918. Work at Pittsburgh along the Monongahela River.

Timber

Position and Prospects of the Home Timber Supply (88401). E. P. Stebbing. 2200 w. Nature—July 18, 1918. Complete destruction of British wood supply for war purposes. Other sources

MEASUREMENT

Breakwater

Mur De Quai Nord Du Môle A Alger (88433 C + D). M. Gauckler. Ills. 6000 w. Ann Ponts Et Chaussées—Mar.-Apr., 1918. Movements of a pier wall at Algiers. Measurements of vibration and settlement.

Latitude

Determination of Latitude and the Meridian (87855). A. C. Callen. 2000 w. Cl Age—July 25, 1918. Directions for using the transit to determine a meridian.

Load Stresses

Equivalent Uniform Loads for Indeterminate Structures (87958 A). D. B. Steinman. Ills. 1500 w. Eng News-Rec—Aug. 1, 1918. Method worked out for ordinary trusses applied to curved influence lines.

Surveys

Topographical Surveys in Connection With Rural Planning (88344). W. H. Norrish. 3500 w. Can Engr—Aug. 22, 1918. Extracts from paper before the Assn. of Dom. Land Survs. The advantages of topographical surveys, what they should show, cost, etc.

Tank Volumes

Volumes of Cylindrical Tanks (87867). M. W. Ward. 900 w. Power—July 30, 1918. Means of finding the quantity of liquid in a given tank at any depth.

Tie Bar Tests

Tests on the Bars from the Menai Suspension Bridge (88287 A). Ills. 2500 w. Engr—July 19, 1918. Reports of tests of bars from a bridge completed in 1826 and more than 90 years in service, with remedial work undertaken.

MUNICIPAL

City Managers

Some Things Engineers Serving as City Managers May Be Expected to Meet (87,-810 A). Thomas H. Reed. 2000 w. Eng News-Rec—July 25, 1918. Problems to be solved.

Refuse

Refuse Collection and the Present Demand for Garbage (88010 A). Samuel A. Greeley. 1500 w. Mun Eng—Aug., 1918. Present demand for garbage. Improved collection service, and methods.

Sewage Disposal

Design and Construction of the New Sewage Treatment Plant at Sedalia, Mo (88012 A). Robert E. McDonnell. Ills. 1500 w. Mun Eng—Aug., 1918. Details of a combined system receiving both sanitary and storm sewage.

Design Details of Proposed Works for the Collection and Disposal of Sewage at Pottstown, Pa. (88008 A). Charles E. Collins. 2500 w. Mun Eng—Aug., 1918. Explains conditions and gives details of plant.

Sprinkling Filter System and Auxiliaries vs. the Activated Sludge Process (88011 A). T. Chalkley Hatton. 4000 w. Mun Eng—Aug., 1918. Advantages and disadvantages of the two methods.

Sewage Treatment

Miles Acid Process May Require Aeration of Effluent (87960 A). F. W. Mohlman. Ills. 1200 w. Eng News-Rec—Aug. 1, 1918. New Haven experiments show that sulphur dioxide in effluent deoxygenates several volumes of diluted water.

Sewer Cleaning

Motor Equipment Reduces Cost of Cleaning Sewer Catchbasins from $3.76 to 60 Cents (88260 A). Ills. 2200 w. Com Vhle—Aug. 15, 1918. Otterson eductor mounted on Kelly-Springfield truck.

Sewer System

Compressed Air Sewage Lifting System of Cairo, Egypt (87921). Map and Ills. 1000 w. Eng & Con—July 31, 1918. Details of the layout and working of the sewer system; 63 Shone ejectors have been sunk.

Traffic

The Space Grabbing Automobile (87,851). 3000 w. Elec Ry Jl—July 27, 1918. Need of regulation at Washington, D. C.

ROADS AND PAVEMENTS

Concrete

Concrete Road Construction During Freezing Temperatures (88091). C. L. Brown. (Abstract from *Public Roads.*) 1500 w. Eng & Con—Aug. 7, 1918. Describes methods employed at Quantico, Va.

How to Get the Best Surface on a Concrete Road (88003 A). A. H. Hunter. 3000 w. Mun Eng—Aug., 1918. Construction features that must be watched.

The Concrete Roadway (88159 D). George A. Rieker. 2200 w. Okla Soc Engrs, Trans—Vol. IV, 1918. Why the author regards concrete the best development in road building.

Cost Keeping

Cost-Keeping System for County Highway Work (88341). H. A. Sewell (Abstract). 2200 w. Can Engr—Aug. 22, 1918. Elements which will apply to all cases.

Earth Roads

Method of Building Earth Roads in Kane County, Illinois (88088). George N. Lamb. Ills. 1000 w. Eng & Con—Aug. 7, 1918. Equipment, surveys, etc.

The Necessity of Engineering Supervision in Construction and Maintenance of Earth Roads (88092). H. Ross Mackenzie. From a paper before Regina Br. of Can. Soc. C. E. 2200 w. Eng & Con—Aug. 7, 1918. Calls attention to costly errors and mistakes.

France

Roads in Base Section of American Forces Require Widening and Resurfacing (88317 A). Robert K. Tomlin, Jr. Ills. 3000 w. Eng News-Rec—Aug. 22, 1918. Heavy traffic necessitates continuous maintenance.

Highways

Fixing the Responsibility in Highway Construction (88161 D). W. S. Gearhart. 4000 w. Okla Soc Engrs, Trans—Vol. IV, 1918. Outlines the Kansas highway system.

Limit Truck Capacity or Build Better Roads (87959 A). 2000 w. Eng News-Rec—Aug. 1, 1918. Discussion by state highway officials shows present construction inadequate for traffic.

Paving

Engineers Advocate Hard Paving on Steep-Grade Streets (88247 A). Ills. 2000 w. Eng News-Rec—Aug. 15, 1918. Practice in using stone, brick and concrete either for full width or for strips in combination with asphalt.

Experiences in Force Account Paving in the City of St. Paul, Minn. (88005 A). Oscar Claussen. 2500 w. Mun Eng—Aug., 1918. Data, arguments and experience favorable to force account paving.

Pavements

Recent Practices in Construction of Tar Surfaces and Pavements (88089). Arthur H. Blanchard (abstract of address at Canadian Good Roads Cong. 3000 w. Eng & Con—Aug. 7, 1918. Outline of American and English practice.

The Action of Water on the Road Subgrade and Its Relation to Road Drainage (88004 A). J. L. Harrison. 2500 w. Mun Eng—Aug., 1918. Limitations of tile drainage, capillary attraction; freezing under pavements, etc.

Road Materials

Typical Specifications for Bituminous Road Materials (87835 N). Prevost Hubbard and Charles S. Reeve. Ills. 60 pp. U S Dept Agri, Bul 691—July 10, 1918. Revised specifications, with methods of test and directions for sampling.

Seepage

Impervious Bituminous Wall Suggested to Prevent Seepage Under Paving (87,956 A). 2200 w. Eng News-Rec—Aug. 1, 1918. Study made of vertical movements of pavements with reference to frost action.

WATER SUPPLY

Dams

Construction of Concrete Dam in Hudson River at Troy, N. Y., 1916 (87836 B). A. C. Harper, and others. Ills. 18 pp. Prof Mem—July-Aug., 1918. Details of the work with reports.

Facing Leaky Rock Fill Dam with Timber Planks (87957 A). George M. Bull. Ills. 2200 w. Eng News-Rec—Aug. 1, 1918. Three rows of creosoted boards were placed on face.

Repair Washout Under Dam by Sheet Pile Cutoff Embedded in Concrete (87,812 A). Ills. 3000 w. Eng News-Rec—July 25, 1918. Cause of accident and methods of repair.

Kutter's Formula

Algae Growths Increase Value of *n* in Kutter's Formula (87811 A). Paul Taylor. Ills. 1200 w. Eng News-Rec—July 25, 1918. Results of studies made in 1912-16 in Tieton irrigation canal, lined with reinforced-concrete blocks.

London

Chemical and Bacteriological Examination of the London Waters (88068). 6000 w. Can Engr—Aug. 1, 1918. From a report of the Metropolitan Water Board for year ending March 31, 1918.

Manchester, Eng.

Water Supply of Manchester (88421). 1100 w. Times Engng Supp—July, 1918. A new project for bringing water from the Lake District in the north of England.

Oklahoma City

Oklahoma City's New Water Supply (88156 D). Guy V. McClure, with discussion. Map and Ills. 4400 w. Okla Soc Engrs, Trans—Vol. IV, 1918. History and description.

Pipe Laying

Cost of Laying Pipe (88340). George Wehrle. 2500 w. Can Engr—Aug. 22, 1918. Information of value to waterworks engineers.

Pumping Station

Conversion of Small Steam Operated Pumping Stations Into Electrically Operated, Automatically Controlled Stations (88[illegible] A). John W. Towne. 1000 w. Mun Eng—Aug., 1918. Problems due to lack of man-power and materials. Examples of successful electrification.

Sault Ste Marie

Sault Ste Marie Water Supply Project (88064). R. O. Wynne-Roberts. Plans. 2000 w. Can Engr—July 18, 1918. Abstracts of sections of recent report. Favors gravity supply from Coldwater Creek.

Sterilization

The Sterilization of London Water (87,889 A). Also editorial. 4800 w. Engr—June 28, 1918. Reviews the last annual report of Sir A. C. Houston dealing with results of chemical and bacteriological examination of London waters.

Storage

Advantages of the Storage of Water (88342). Melville C. Whipple. 2500 w. Can Engr—Aug. 22, 1918. Abstract of paper read before School of Public Health, Boston. Advantages, disadvantages and dangers.

Water Treatment

Water Softening to Correct Boiler Corrosion (88030). William Henry Hobbs. 3500 w. Ry Rev—Aug. 3, 1918. Considers water treatment to prevent incrustation, corrosion, etc.

Fully Metered Plant Treats Highly Turbid Arkansas for Tulsa (87955 A). Ills. 2500 w. Eng News-Rec—Aug. 1, 1918. Features of the plant for treating Arkansas River water.

Waterworks

Galt Waterworks (87813). W. F. Sutherland. Ills. 2000 w. Pr House—July, 1918. Combined steam and hydro-electric pumping station. Spring water of exceptional purity used.

War Burdens of Water-Works of United States Increase (88245 A). 3000 w. Eng News-Rec—Aug. 15, 1918. From a report to the executive committee of the American Water-Works Assn., made by Leonard Metcalf, George A. Johnson and George W. Fuller.

Wells

Increasing the Well Water Supply of Montgomery, Alabama (88007 A). A. O. Beauchemin. 1500 w. Mun Eng—Aug., 1918. Describes the present well water supply, the proposed development, and results of studies made.

Grouting Wells in Rock Formation Effective and Simple (88321 A). Ills. 1300 w. Eng News-Rec—Aug. 22, 1918. General principles, advantages, examples and cost.

Special Cast Iron Lining of Two Large Bore Wells (88235). W. H. Maxwell. Ills. 2500 w. Eng & Con—Aug. 14, 1918. Work at Tunbridge Wells, England.

WATERWAYS AND HARBORS

Barge Canal

The New York State Barge Canal (88,288 A). Ills. 2800 w. Engr—July 19, 1918. Serial, 1st part. Detailed description of the remodelling and improving of the system of canals comprised in this undertaking.

Canals

The Leclaire Canal on the Mississippi River (88291 A). 800 w. Engr—July 19, 1918. Details of a canal under construction along the Iowa shore of the Mississippi River, to provide a slack-water channel through the Rock Island rapids.

Docks

American-Built Docks in France Completed by Pacific Coast Engineers (87953 A). Robert K. Tomlin, Jr. Ills. 5500 w. Eng News-Rec—Aug. 1, 1918. Details of work of engineer requirements.

Dredging

The Economics of Ladder Dredgers and Steam Hoppers (87918). Harold Berridge. 2000 w. Eng & Con—July 31, 1918. Methods of effecting comparisons of cost of dredging.

Dry Docks

The Sidehaul Railway Dry Dock at West Memphis, Arkansas (88363 B). Clarke S. Smith. Ills. 6 pp. Prof Mem—July-Aug., 1917. Details of construction and equipment.

Champlain Dry Dock for Quebec Harbor (88[illegible] N). U. Valiquet. Ills. [illegible] w. Can Soc C E—April 25, 1918. States conditions and describes the new dock.

To avoid error, please order by title and number only.

Construction of the Pearl Harbor Drydock Completed (87809 A). Ills. 2500 w. Eng News-Rec—July 25, 1918. Novel methods used in Honolulu harbor.

New Dry Dock at Quebec (88423). 1600 w. Times Engng Supp—July, 1918. Dock 1150 feet long, almost finished. Construction methods, equipment, etc.

French Ports

L'Exploitation Des Ports Maritimes (88406 E). C. Lavaud. 3600 w. Mem Soc Ingénieurs Civils De France—Jan.-Mar., 1918. Improvements undertaken at French sea ports during the war.

Holland

De scheepvaartweg van Amsterdam naar den Rijn (88403). C. A. Joles. Ills. 10,000 w. Ingenieur—June 22, 1918. Proposed ship canal from Amsterdam to the Rhine.

De verbetering van de Overrijsselsche Vecht (88402). N. C. Lambrechtsen. Ills. 11,000 w. Ingenieur—June 15, 1918. Plans for improvement of the Vecht river.

Levees

Levee Settlement: Cause and Remedy (88315). 1200 w. Eng & Con—Aug. 21, 1918. Information from the last annual report of the Board of State Engineers of Louisiana.

New Orleans

New Orleans Builds Inner Harbor and Navigation Canal (88244 A). Ills. 2500 w. Eng News-Rec—Aug. 15, 1918. Construction of ocean docks and industrial sites on fixed level waterway.

New Zealand

Shipping and Navigation in the Port of Otago, N. Z. (88144 N). McG. Wilkie and J. Blair Mason. Ills. 1500 w. Comwh Engr—July, 1918. Abstracted from official reports.

Sea Walls

Repointing Sea Wall at Governors Island, N. Y., with Cement Gun (88364 B). Henry N. Babcock. Ills. 9 pp. Prof Mem—July-Aug., 1917. Details.

Terminals

Marine Terminals for Inland River Cities Located on High Ground (88056 A). H. M. L. Harding. Ills. 2000 w. Int Mar Eng—Aug., 1918. Principles governing construction of efficient river terminals.

Wharf Supports

Concrete Wharf Supports in San Francisco Harbor (88365 B). Thomas S. Williams. 6 pp. Prof Mem—July-Aug., 1917. Describes concrete piles and concrete cylinders, giving experience with both.

MISCELLANY

Fortifications

Old and New Opinions About the Value of Permanent and Fortified Positions (87840 B). 24 pp. Prof Mem—July-Aug., 1918. Serial, 1st part. Their advantages and disadvantages, method of employment and defense, etc.

Hering; Rudolph

Looking Back Half a Century (88087 A). Charles Whiting Baker. Photograph. 2500 w. Eng News-Rec—Aug. 8, 1918. Biographical sketch of Rudolph Hering.

Military Engineering

A Visit to the English Front in France (88367 B). D. Victoriano Casajus. Ills. 27 pp. Prof Mem—July-Aug., 1917. Serial, 1st part. Impressions from observations of conditions prevailing there.

Sandbox Instruction

Sandbox Instruction in Fortification, Reconnaissance and Minor Tactics (87837 B). V. L. Peterson. Ills. 20 pp. Prof Mem—July-Aug., 1918. Field fortification instruction and advantages to officers.

MARINE AND NAVAL ENGINEERING

Cargo Ships

Design and Construction of Self-Propelled Reinforced Concrete Sea-Going Cargo Steamers Now Building in Great Britain (88053 A). T. G. Owens Thurston. Ills. 4500 w. Int Mar Eng—Aug., 1918. Read before Instn. Nav. Archts., London.

Concrete Barges

Concrete Barges (88051 A). Louis L. Brown. Ills. 1000 w. Int Mar Eng—Aug., 1918. Design, method of construction, materials used, method of waterproofing and launching.

Concrete Barges Designed for New York State Canal (88086 A). Ills. 700 w. Eng News-Rec—Aug. 8, 1918. Plans for 500-ton tow-boats soon to be put in service.

Concrete Ships

Concrete Ship Policy Defended (88251). A. Piez. 3000 w. Naut Gaz—Aug. 17, 1918. Shipping Board heads explain why no more vessel contracts are let.

Problems of Designing the Reinforced-Concrete Ship (87808 A). From paper by Messrs. Wig and Hollister before Am. Concrete Inst. Diagrams. 4000 w. Eng News-Rec—July 25, 1918. Problems met by the Emergency Fleet Corporation.

Concrete Ships of 3,500 Tons Deadweight Designed by Emergency Fleet Corporation (88050 A). Ills. 1200 w. Int Mar Eng—Aug., 1918. Detailed description.

Construction of Concrete Ships for Emergency Fleet Corporation (88152). R. J. Wig. Abstract of report to Edward N. Hurley. Ills. 1000 w. West Eng—Aug., 1918. Describes the 3,500-ton type of vessel.

Les Remorquers En Béton Armé (88431 B). G. Espitallier. Ills. 2500 w. Génie Civil—July 27, 1918. Tow boats built of concrete at French yards. Design and details.

Lightning Hazard of Concrete Ships (88104). H. W. Spang. 1000 w. Naut Gaz—Aug. 10, 1918. Precautions necessary.

Corrosion

Corrosion of Ships (88347). From Liverpool *Jl of Com.* 1200 w. Naut Gaz—Aug. 24, 1918. Corrosion by chemical and by galvanic action.

Cruisers

Model Experiments on Express Cruisers of Deadrise Type (88055 A). T. A. Gamon. 1000 w. Int Mar Eng—Aug., 1918. Type proves superior to round bilge model.

Electric Welding

Electric Welding In Ship Work (88416). 1000 w. Times Engng Supp—July, 1918. Vessel built in England with electrically welded plates.

Britain's First Rivetless Ship (88253). 1500 w. Naut Gaz—Aug. 7, 1918. Possibilities and disadvantages of the electric welding process are discussed.

Instruments

The Type V Azimuth Circle (88177 A). H. R. Greenlee. Ills. 2200 w. U S Nav Inst, Pro—July, 1918. Designed, primarily, for use in connection with the gyro-compass, but may be used with the magnetic compass.

Marine Forgings

The Production of Large Marine Forgings (87990). A. G. Webster. Ills. 1700 w. Mar Eng, Can—June, 1918. Suitable equipment made possible quick delivery.

Marine Railway

Features of an Electrically Operated Marine Railway (88374). Ills. 1500 w. Elec Rev, Chi—Aug. 24, 1918. Installation on Illinois River served by Central Station Co.

Merchant Marine

Putting Our Merchant Ships on Schedule (88449 A). L. P. Alford. 2500 w. Ind Man—Sept., 1918. A series of Gantt charts for showing the movement of our ships, and their location at any time, as well as cargoes in kind and amount.

Naval Station

The Pelham Bay Naval Reserve Training Station (87996 B). Ills. 3000 w. Arch For—July, 1918. Detailed description of this camp.

Oil Fleet

When Tanker Displaced the Whaler (87818). Ills. 1200 w. Naut Gaz—July 27, 1918. Growth of Standard Oil fleet.

Propellers

Half a Million Propellers a Year (87988). Henry Woodhouse. Ills. 1300 w. A A Wkly—Aug. 5, 1918. Serial, 1st part. How they are made.

Propulsion

Electric Propelling Machinery for the U. S. Battleship "Tennessee" (87948 A). Wilfred Sykes. Ills. 2500 w. Elec Jl—Aug., 1918. Describes equipment.

Reduction Gear

Neuland Magnetic Reduction Gear (87992). Ills. 1500 w. Mar Eng, Can—July, 1918. Details of construction and operation.

Salvage

The Admiralty Salvage Section (87900 A). Ills. 1500 w. Engng—July 5, 1918. Reviews some of the work on the British coast.

With the Admiralty Salvage Section (88135 A). 2500 w. Engr—July 12, 1918. Recent examples of salvage, with account of methods used.

Merchant Vessel Salvage (88418). 1000 w. Times Engng Supp—July, 1918. Methods of salvaging sunken ships.

Shipbuilding

A New Shipyard on the North-East Coast (88398 A). Ills. 700 w. Engr—July 26, 1918. Description of the new yard of the Furness Shipbuilding Co.

Builds Plant While Fabricating Ships (87826 A). E. C. Kreutzberg. Ills. 1000 w. Mar Rev—Aug., 1918. Simultaneous ship and plant construction in new Atlantic yard.

Hog Island's Compressed Air System (87827 A). Ills. 1000 w. Mar Rev—Aug., 1918. Details of equipment.

Seattle Shipbuilders Overcome Pioneer Difficulties and Set New Speed Records (87806 A). Claude A. Osier. Ills. 3000 w. Eng News-Rec—July 25, 1918. Development of the Skinner & Eddy shipbuilding plant.

Shipbuilding in the United States (87890 A). Ills. & Plates. 2200 w. Engr—June 28, 1918. Deals particularly with the Hog Island yard.

Ship Construction (88285 A). Ills. 1200 w. Engng—July 19, 1918. Details of construction with multiple punched plates.

The Building of the Tuckahoe (88226 A). E. A. Suverkrop. Ills. 1500 w. Am Mach—Aug. 15, 1918. How a 5,500-ton steam collier was built in 27 days from the laying of the keel.

War Time Effort at Toronto Ship Building Co.'s Plant (87991). A. G. Webster. Ills. 2500 w. Mar Eng, Can —July, 1918. Wooden ships being built to the same design as on the Pacific coast.

Shipping

Shipping Handled With Precision of Railroad Train Movements (88242). 1500 w. Mfrs Rec—Aug. 15, 1918. Remarkable achievements made.

Shipyards

American Shipyard Data (87984). Map. 1500 w. Naut Gaz—Aug. 3, 1918. List of plants with number of vessels under contract, according to districts.

Concrete Shipyard at Wilmington, N. C. (88052 A). A. G. Monks. 2500 w. Int Mar Eng—Aug., 1918. Details of plant erected by Liberty Shipbuilding Co., Boston, Mass., for building concrete ships.

Maine Shipyards Again Active (88252). 2000 w. Naut Gaz—Aug. 17, 1918. Report of rapid vessel production.

The National Shipyards (87898 A). 1500 w. Engng—July 5, 1918. Editorial on the report of the Select Committee of the House of Commons on National Expenditure.

Shipyard Sanitation

Design and Construction of Water and Sewerage Works at the Hog Island Shipyard (88006 A). W. H. Blood, Jr. Ills. 1700 w. Mun Eng—Aug., 1918. Detailed description; difficulties, etc., at this great establishment.

Smoke

How Can Soft Coal Be Burned Without Smoke in Marine Boilers? (88054 A). 1800 w. Int Mar Eng—Aug., 1918. Mechanical stoking and use of pulverized coal advocated. Details of equipment required.

Storage Batteries

Floating the Storage Battery on the Line (88176 A). Lucius C. Dunn. Ills. 24 pp. U S Nav Inst, Pro—July, 1918. Deals with application to submarines.

Tonnage

What Is Ship Tonnage? (88343). S. M. Meeker, Jr. 1000 w. Can Engr—Aug. 22, 1918. Explanatory.

Torpedo Attacks

Moving Targets and Torpedo Attack (87892 A). 4000 w. Engr—June 28, 1918. Serial, 1st part. Construction and operation of torpedoes.

Turbines

2,500 H. P. Rateau Marine Geared Turbines (88136 A). Ills. 2000 w. Engr—July 12, 1918. Detailed description of turbine built by the British Westinghouse Co.

Turbines and Reduction Gears in the Merchant Marine (87946 A). J. A. Davies. Ills. 2000 w. Elec Jl—Aug., 1918. Propelling machinery built by the Westinghouse Machine Co.

Wooden Vessels

Revival of Wooden Ships (87983). 2200 w. Naut Gaz—Aug. 3, 1918. Emergency vessels.

MINING AND METALLURGY

Copper

The Southwest Copper Field (88037 A). J. R. Finlay. Ills. 5000 w. Eng & Min Jl—Aug. 3, 1918. Geologic, economic and climatic aspects of this section.

Copper Castings

Copper Castings for Electrical Purposes (88306). G. F. Comstock. 1200 w. Br Wld—Aug., 1918. Development of copper purification.

Tin

The Tin Field of North Dundas (88170 N). Hartwell Conder. Maps & Ills. 96 pp. Tas Geol Surv Bul—No. 26. History of mining on the field, physiography, geology, mining properties, etc.

Zinc

A New Method of Estimating Zinc in Zinc Dust (88356 A). L. A. Wilson. Ills. 2500 w. Eng & Min Jl—Aug. 24, 1918. Improved hydrogen evolution for chemical analysis of zinc dust.

Benefits To Be Derived From Close Coöperation of Zinc Mining and Smelting Interests In Helping Win the War (88039 A). W. R. Ingalls. 5000 w. Eng & Min Jl—Aug. 3, 1918. Address before Am. Zinc Inst., in St. Louis. Review of the industry in the United States.

Spelter Statistics for 1917 (87864 A). W. R. Ingalls. 5500 w. Eng & Min Jl—July 27, 1918. Revised statistics of production in the United States in 1917.

Zinc in Missouri, Kansas, Oklahoma and Arkansas (88283 A). Otto Ruhl. 2000 w. Eng & Min Jl—Aug. 17, 1918. Zinc concentrates, prices, cost, etc.

COAL AND COKE

British Coal

The War and British Coal Supplies (88237). Mark Meredith. 5000 w. Cl Age—Aug. 15, 1918. Coal industry, and economies under government regulation.

Byproducts

The Wastage of Coke Byproducts (88150 A). Frederick MacCoy. Ills 1000 w. Eng & Min Jl—Aug. 10, 1918. Plea for more extended use of the byproduct coking oven.

Coke-Oven By-Products in 1917 (87901 A). 4500 w. Colly Gdn—July 12, 1918. Report under the Alkali Works act.

Carbonization

Low-Temperature Carbonization (88133 A). Edgar C. Evans. Abstract of paper before Soc. of Chem. Ind. 4000 w. Colly Gdn—July 26, 1918. Differences between high and low carbonization.

Coal

Coal, Explosives, War—I. (87853). H. J. Broughton. Ills. 3000 w. Cl Age—July 25, 1918. Serial, 1st part. Relation that coal bears to business and particularly to the conduct of war.

Coal Analyses

Analyses of Mine and Car Samples of Coal Collected in the Fiscal Years 1913 to 1916 (87833 B). Arno C. Fieldner, Howard I. Smith, J. W. Paul, and Samuel Sanford. 456 pp. U S Bur Mines—Bul 123. Sampling and analytical methods with tabulated analyses.

Coal Fields

The Dombrova Coal Fields (87975 A). Arthur E. Gurney. 1800 w. Colly Gdn—July 19, 1918. Mines in Poland.

Coal Problem

The Coal Problem Under War Conditions (88474). H. H. Stoek. 4000 w. Cl Age—Aug. 29, 1918. Suggestions for coal storage and other problems.

Coal Rights

Provincial Rights Dispute in Canada (88328). Robert Dunn. Map. 1500 w. Cl Age—Aug. 22, 1918. Title to coal-bearing lands of Vancouver Island in dispute.

Coal Seams

Notes on Faults and Rolls in Coal Seams (87886 A). Idris Thomas. Ills. 2500 w. Ir & Cl Trds Rev—May 31, 1918. Read before S. Wales Branch of Natl. Assn. Colly. Mgrs. Personal observations.

Coal Storage

The Storage of Soft Coal (87870). W. L. Abbott. 2000 w. Power—July 30, 1918. Methods of preventing spontaneous combustion.

Coal Storage in Large Quantities (88440 A). H. J. Edsall. Ills. 5000 w. Ind Man—Sept., 1918. Modern methods.

Coal Waste

See same heading under Mechanical Engineering, *Heating and Cooling.*

Coke Industry

An Innovation in the Coke Industry (88071). John L. Gans. 2000 w. Cl Age —Aug. 8, 1918. Byproduct-coke manufacturer at Swedeland, Penn.

Development of the Coke Industry in Colorado, Utah, and New Mexico (88208 D). F. C. Miller. 4 pp. A I M E, Bul —Aug., 1918. Reviews the history.

Coking

Some Characteristics of American Coals in By-Product Coking Practice (88196 B). F. W. Sperr, Jr. Ills. 30 pp. Fkn Inst, Jl—Aug., 1918. Importance of the development.

Collieries

The Britannia Colliery, Pengam, Mon. (88132 A). George Hann. From a paper before S. Wales Inst. of Engrs. Ills. 4500 w. Colly Gdn—July 26, 1918. Machinery electrically driven — No steam boilers at the colliery.

Gaseous Mines

Instantaneous Outburst of Coal and Gas at Bedford Collieries, Leigh (88373 N). F. N. Siddall, with discussion. Ills. 10 pp. Instn Min Engrs, Trans—July, 1918. Explains plan of working.

Longwall

Coal Mining and Man Power (88327). F. A. Pocock. 1500 w. Cl Age—Aug. 22, 1918. Argues that longwall method would increase output of bituminous.

Longwall Mining at La Salle, Illinois (88473). George W. Harris. Map & Ills. 4000 w. Cl Age—Aug. 29, 1918. Method described.

Marcus Screen

Marcus Screen at Plants of the Carnegie Coal Co., Pennsylvania (87856). Richard G. Miller. Ills. 2500 w. Cl Age—July 25, 1918. The combined screen and picking table has proved its value in the preparation of coal.

Mining Methods

Coal Mining in Carbonado, Washington (88238). F. G. Jarrett. Ills. 3000 w. Cl Age—Aug. 15, 1918. Longwall worked on a steeply pitching bed. Other difficulties.

Methods of Operation (88239). J. F. K. Brown. 2500 w. Cl Age—Aug. 15, 1918. Considers factors influencing methods to be adopted in coal mining.

Scraper Mining of Thin Bed Anthracite (88240). E. P. Humphrey. Ills. 2500 w. Cl Age—Aug. 15, 1918. Describes method that has been reasonably successful.

Orient Mine

Orient Mine of Franklin County, Illinois (88326). George W. Harris. Ills. 3000 w. Cl Age—Aug. 22, 1918. Detailed description of mine and methods.

Production

Can Output Be Increased Scientifically? (88329). W. E. Joyce. 1500 w. Cl Age—Aug. 22, 1918. Thinks modern science might be used to good effect.

Coal Production and Lubrication (87857). Reginald Trautschold. 2000 w. Cl Age—July 25, 1918. A plea for the use of semi-grease compounds for service in coal mines.

Pulverized Coal

Pulverized Coal for Industrial Purposes (87903 A). J. Cunliffe. 2000 w. Colly Gdn—July 12, 1918. Preparation, application, and burning.

Separation

A New Method of Separating Slate from Coal (88126 A). H. M. Chance, with discussion. Ills. 7500 w. E Cb Phila, Jl—Aug., 1918. Describes a new gravimetric method, which depends on the differences in the specific gravity.

Winding Plant

Notes on the Overhead Koepe Winding Plant at Plenmeller Colliery, Haltwhistle, Northumberland (88371 N). George Raw. Ills. 18 pp. Instn Min Engrs, Trans—July, 1918. Description of plant and report of experience gained.

Electric Winding Engines and Mine Hoists (87914 A). H. H. Broughton. 3500 w. Elec'n—July 5, 1918. Serial, 1st part. The present article defines the scope of the work and gives notes on the question of power supply.

GEOLOGY

Australia

Recent Earth Tremors in Western Australia (88141 N). A. Montgomery. Abstract of report to Minister of Mines. 2500 w. Chem Eng & Min Rev—July, 1918. Interaction of geological causes and mining operations.

British Columbia

The Copper Silver Veins of the Telkwa District, British Columbia (88312 B). V. Dolmage. Ills. 32 pp. Ec Geol—July, 1918. Summary of results of an investigation of the geology and mineral deposits of this district.

Colorado

The Whitepine Section of the Tomichi District (88355 A). James E. Dick. Ills. 2000 w. Eng & Min Jl—Aug. 24, 1918. Geological and mining conditions. Ores developed show lead, zinc, copper and silver sulphide containing some gold.

Iron Deposits

The Iron-Formation on Belcher Islands, Hudson Bay, with Special Reference to Its Origin and Its Associated Algal Limestones (88171 C). E. S. Moore. Ills. 26 pp. Jl Geol—July-Aug., 1918. Topography, geology, etc.

London Basin

The Palaeozoic Platform Beneath the London Basin and Adjoining Areas, and the Disposition of the Mesozoic Strata Upon it (87904 A). Herbert Arthur Baker. Maps. 3000 w. Ir & Cl Trds Rev—July 12, 1918. Serial, 1st part. Geological problems of interest.

Magnesite

Notes on the Possible Origin of the Magnesite near Valley, Washington (88313 B). Olaf P. Jenkins. Ills. 800 w. Ec Geol—July, 1918. Describes the deposits and suggests their origin.

Molybdenite

Molybdenite Operations at Climax, Colorado (88198 D). D. F. Haley. 5 pp. A I M E, Bul—Aug., 1918. Geology of the deposit, mining system, milling plant and practice, etc.

Oil Geology

The Movements of Oil and Gas Through Rocks (88311 B). Victor Ziegler. 13 pp. Ec Geol—July, 1918. Views as to the causes of migration.

Pyrite

Pyrite Deposits of Leadville, Colo. (88,200 D). Howard S. Lee. 5 pp. A I M E, Bul—Aug., 1918. Geology and ore occurrence, method of mining, etc.

Veins

The Mechanics of Vein Formation (88,199 D). Stephen Taber. Ills. 34 pp. A I M E, Bul—Aug., 1918. Six different methods, with summary and conclusions.

IRON AND STEEL

Blowing Engine

1500 H.P. Gas Blowing Engine (87,942 A). 1200 w. Engr—July 5, 1918. Illustrated detailed description.

Carbon Determination

Combustion Train for Carbon Determination (88310 A). J. B. Stetser and R. H. Norton. Ills. 3300 w. Iron Age—Aug. 22, 1918. Apparatus giving results in 6 min. and meeting color test inaccuracies arising from varying heat treatment of samples.

Corrosion

The Corrosion of Iron and Steel and Its Prevention (88303). Abe Winters. 1500 w. Can Fndman—Aug., 1918. Important factors in the process of sherardizing. Requirements.

Damascene

Damascene Steel (88400). 1000 w. Nature—June 20, 1918. Abstract of paper at British Iron and Steel Institute.

Electric Furnaces

Electric Heating and Heat Treating (87980). T. F. Baily. Ills. 1500 w. Auto Ind—Aug. 1, 1918. The advantages of the electric furnace for forge shop use.

La Production Électrothermique Des Fontes Et Aciers (88409 B). J. Escard. Ills. 5500 w. Revue Générale Des Sciences—June 30, 1918. Serial, 1st part. Various types of electric steel and blast furnaces described.

The Webb Electric Steel Furnace (87,930 A). Ills. 2000 w. Iron Age—Aug. 1, 1918. A high voltage unit developed and operated by the Old Dominion Iron & Steel Corporation.

Electric Steel

Electric Steel ([illegible] A). Franklin D. Jones. Ills. [illegible] w. Mach—Aug., 1918. Applications of the electrical process in tool making; its advantages.

Furnace Roofs

Silica Brick in Open-Hearth Furnace Roofs ([illegible] A). [illegible] w. Iron Age—Aug. 1, 1918. Deterioration as observed by French authorities.

Iron Supplies

Furnace Interests Control the Distribution of Iron (88010). 1800 w. Foundry—Aug., 1918. Essential industries will be first supplied.

Production

Rules Governing Priority Are Revised (87931 A). 3500 w. Iron Age—Aug. 1, 1918. Revision of rules and regulations governing priority in production of iron.

Steel Plant

Canadian National Steel Plant (88300). Ills. 3000 w. Can Fndman—Aug., 1918. Details of plant layout, equipment, etc.

Stellite

Quelques Observations Sur Le Stellite (88407 C + D). L. Guillet and H. Godfroid. Ills. 1200 w. Revue De Métallurgie—July-Aug., 1918. Notes on Stellite: structure, chemical analysis, etc.

MINE OPERATION

Axles

Mine-Car Axles (87952). B. P. Lieberman. Ills. 2500 w. Cl Age—Aug. 1, 1918. Proper size, structure, ductility, material, etc.

Blasting

Blasting Methods at Ajo (88155). S. U. Champe. Ills. 1000 w. West Eng—Aug., 1918. Work in copper ore in advance of the steam-shovel used in open-cut work in Arizona.

Cementation Process

The Cementation Process at the Hatfield Main Sinking (87906 A). H. N. Berry, with discussion. 4500 w. Ir & Cl Trds Rev—July 12, 1918. An account of the use of this process in sinking through water-bearing strata.

Drills

A Gasoline-Driven Diamond-Drill Outfit (88358 A). J. M. Longyear, Jr. 2500 w. Eng & Min Jl—Aug. 24, 1918. Successful operation in northern Michigan iron-ore district.

Excavator

The Tailing Excavator at the Plant of the New Cornelia Copper Co., Ajo, Ariz. (88201 D). Franklin Moeller. Ills. 6 pp. A I M E, Bul—Aug., 1918. Details.

Mechanical Equipment

Conservation of Miners by Employment of Mechanical Equipment (87854). R. L. Herrick. Ills. 4000 w. Cl Age—July 25, 1918. How the introduction of modern machinery conserves man-power.

An Electrically Interlocked Car Haul and Car Feeder (88236). R. R. Hines. Ills. 1500 w. Cl Age—Aug. 15, 1918. Describes the two pieces of apparatus.

Mine Dust

Dust Prevention in Transvaal Mines (88149 A). Arthur C. Whittome and J. H. Veasey. Exerpt from paper before So. Af. Inst. of Engrs. 5500 w. Eng & Min Jl—Aug. 10, 1918. Review of Methods used for allaying dust and improving ventilation.

Mine Gas

Testing for Gas in Mines (87951). H. E. Gray. Ills. 1800 w. Cl Age—Aug. 1, 1918. Important features of a good testing lamp, and the value of the sight indicator.

Mine Plant

New Plant of Pioneer Operations in Franklin County, Illinois (88070). George W. Harris. 2800 w. Cl Age—Aug. 8, 1918. Reviews development of this field.

Mine Water

Handling Mine Water ([illegible]). Henry F. Cole. Ills. 2200 w. Cl Age—Aug. 8, 1918. The points to be considered before selecting a pump.

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Oklahoma

Mining and Milling in the Miami Field of Oklahoma (88158 D). Edgar Z. Wallower. 1200 w. Okla Soc Engrs, Trans—Vol. IV, 1918. Features of interest in the mining and milling of lead and zinc.

Pumping Engines

Two Newcomen Atmospheric Pumping Engines (88392 A). Gerald T. Newbould. Ills. 2000 w. Colly Gdn—Aug. 2, 1918. Describes the Westfield engine and the Elsecar engine. Two of the oldest engines.

Safety Lamps

Notes on Safety Lamp Installation at Plenmeller Colliery, Haltwhistle, Northumberland (87884 A). George Raw, with discussion. 2500 w. Ir & Cl Trds Rev—May 31, 1918. Reason for favoring the electric safety lamp.

Sandfilling

Further Notes on Sandfilling of Mines (87795 N). C. H. Greathead. Ills. 2000 w. Chem, Met & Min Soc of S Af, Jl—April, 1918. Minor alterations.

Shafts

Shaft for Water Hoisting and Ventilation (88475). Ills. 2200 w. Cl Age—Aug. 29, 1918. Details of combination.

Steel Guides in Shafts (88254 N). James Whitehouse, with short discussion. Ills & Plate. 2500 w. So Af Instn Engrs, Jl—June, 1918. Results obtained by use of slotted steel guides in deep-level mines.

The Repair of a Circular Shaft of Small Diameter (88372 N). Stewart Chambers. Plate. 6 pp. Instn Min Engrs, Trans—July, 1918. Describes conditions.

MINES AND DISTRICTS

Brazil

Iron and Steel in Brazil (88422). 1100 w. Times Engng Supp—July, 1918. How the iron industry is being encouraged.

Canada

Annual Report on the Mineral Production of Canada During the Calendar Year 1916 (88256 N). John McLeish. 235 pp. Can Dept Mines—No. 474. Statistical.

Cuba

Nuestra Excursion a Matahambre (88,408 A). J. I. Del Corral. Ills. 11,500 w. Rev Soc Cubana De Ingenieros—July, 1918. Copper mines at Matahambra, in Pinar del Rio.

Mine Surveying

The Future Aspect of Mine Surveying (87074 A). John Proctor. 3500 w. Colly Gdn—July 19, 1918. Shows inaccuracies in mine surveying.

Tasmania

The Bangor Mineral District (88169 N). W. H. Twelvetrees. Ills. and Map. 17 pp. Tas Geol Surv Bul—No 27. The locality, geology, slate quarrying, etc.

MINOR MINERALS

Alunite

Recently Recognized Alunite Deposits at Sulphur, Humboldt County, Nevada (87861 A). I. C. Clark. Ills. 3000 w. Eng & Min Jl—July 27, 1918. Important as a possible source of potash.

Clay

Report on the Clay Resources of Southern Saskatchewan (88257 N). N. B. Davis. Ills. 89 pp. Can Dept Mines—No. 468. Based on field work and laboratory tests.

Graphite

Graphite in 1917 (87834). Henry G. Ferguson. 22 pp. U S Geol Surv, II :8—July 26, 1918. Uses, production, etc.

Mica

Mica in 1917 (88168). Waldemar T. Schaller. 12 pp. U S Geol Surv, II :13—July 20, 1918. Production, prices, etc.

Nickel

Canada's Nickel Industry (88066). 2500 w. Can Engr—July 12, 1918. Report of Royal Commission.

Potash

The Prospects of Founding a Potash Industry in This Country (88173 A). K. M. Chance, with discussion. 6500 w. Ir & Cl Trds Rev—July 26, 1918. Abstract of paper before Soc. Chem. Ind. (England). Account of development work.

Salt

The Salt Trade of the United States (88393 A). Ills. 3000 w. Engng—July 26, 1918. Serial, 1st part. Mainly information from a report by W. C. Phalen on the "Technology of Salt Production in the Union."

Slate

Slate in 1917 (88058). G. F. Loughlin. 18 pp. U S Geol Surv, II :9—July 30, 1918. Production, etc.

OIL AND GAS

Berea Sand

Lithology of the Berea Sand in Southeastern Ohio, and Its Effect on Production (88210 D). L. S. Panyity. Ills. 4 pp. A I M E, Bul—Aug., 1918. A study of this oil and gas producer.

Natural Gas

Present Situation Relating to the Introduction and Use of Natural Gas in New Orleans (88194 A). Howard Eggleston. 1200 w. La Eng Soc, Pro—Aug., 1918. Past and present conditions.

Oil Fields

Texas Ranger Oil Field Reaches National Importance (88241). 1200 w. Mfrs Rec—Aug. 15, 1918. Pronounced one of the greatest in the world.

Oil Geology

See same heading under Geology.

Oil Industry

The Oil Industry and Its Relation to War (88346). 3500 w. Mfrs Rec—Aug. 22, 1918. Extracts from addresses of M. L. Requa and A. C. Bedford.

Oil Wells

Staggering Locations for Oil Wells (88209 D). Roswell H. Johnson. 5 pp. A I M E, Bul—Aug., 1918. Suggestions for assisting the producer in planning.

Petroleum

Petroleum and Natural Gas (88129 A). Ills. 4000 w. Aust Min Std—June 27, 1918. Serial, 1st part. History, occurrence, origin, chemistry, production, etc.

Producer Gas

See same heading under MECHANICAL ENGINEERING, *Combustion Motors.*

ORE DRESSING

Condensation

The Condensation of Zinc from Its Vapor (88212 D). Charles H. Fulton. Ills. 20 pp. A I M E, Bul—Aug., 1918. Experimental study and investigations.

Crushing

Crushing Resistance of Various Ores (88203 D). Luther W. Lennox. 10 pp. A I M E, Bul—Aug., 1918. Investigations and results, with screen analyses.

Flotation

The Effect of Addition Agents in Flotation (88259 N). Martin Harmon Thornberry and Horace Tharp Mann. Ills. 40 pp. Sch Mines & Met, Mo., Bul—Nov., 1917. Part 1st covers sulphates, hydroxides and nitrates.

The Ruth Flotation Machine (87859). Arthur J. Hoskin. Ills. 2000 w. Min & Sci Pr—July 27, 1918. Principle utilized; function of oil in frothing; results.

Furnaces

The New American Spirlet Roaster (88282 A). F. J. Harlow. Ills. 4000 w. Eng & Min Jl—Aug. 17, 1918. Describes modifications adopted.

Oliver Filter

Filter Adjustments at Packard Mill At Rochester, Nevada (88038 A). F. Dean Bradley. Ills. 1800 w. Eng & Min Jl—Aug. 3, 1918. Improvements.

Precipitation

Effect of Oxygen Upon the Precipitation of Metals From Cyanide Solutions (88205 D). Thomas B. Crowe. 4 pp. A I M E, Bul—Aug., 1918. Experimental investigations.

Electrostatic Precipitation (88207 D). O. H. Eschholz. Ills. 12 pp. A I M E, Bul—Aug., 1918. Describes systems of fume precipitation and applications.

Refinery

Construction and Operation of an Electrolytic Copper Refinery (88357 A). J. E. McAllister. 4000 w. Eng & Min Jl—Aug. 24, 1918. Estimated cost.

Smelting

Electric Plant at a Canadian Smelting Works (88134 A). Ills. 3500 w. Engr—July 12, 1918. Details of plant at Anyox, British Columbia.

PRECIOUS METALLURGY

Africa

Les Mines D'Or Du Nord-Ouest De Madagascar (88405 E). E. Bernet. Ills. 3200 w. Mem Soc Ingénieurs Civils De France—Jan.-Mar., 1918. Location and estimated amounts of gold.

Cobalt, Ont.

Silver Deposition and Enrichment at Cobalt, Ont. (88314 B). J. A. Reid. Ills. 2200 w. Ec Geol—July, 1918. Critical discussion of paper by Dr. E. S. Bastin. Results of microscopic study.

Cyanide Plant

Fine-grinding Cyanide Plant of Barnes-King Development Co. (88206 D). J. H. McCormick. Ills. 8 pp. A I M E, Bul—Aug., 1918. Details.

Gold

The Elko Prince Mine and Mill (88202 D). J. V. N. Dorr and L. D. Dougan. Ills. 20 pp. A I M E, Bul—Aug., 1918. Geology, development, mining and milling practice, power plant and construction costs.

The Vital Need for Gold (88359 A). John Clausen. 1800 w. Eng & Min Jl—Aug. 24, 1918. Notes on the relation between specie and paper money.

Gold Mining

The Crisis in Gold Production—Congress Must Act (87862 A). B. L. Thane. 3500 w. Eng & Min Jl—July 27, 1918. Plea for the readjustment of the market value of gold on the basis of cost. Problems involved.

The Menace to Gold Mining (87860). 4500 w. Min & Sci Pr—July 27, 1918. Proposal for re-habilitation of gold; testimony of Hennen Jennings before the Ways and Means Committee.

Gold Recovery

The Sodium Sulphide Process of Gold Recovery (88233 N). F. Wartenweiler. 15 pp. Instn Min & Met, Bul 166—July 25, 1918. Outlines metallurgy at Prestea mine, West Africa.

Roasting

Roasting for Amalgamating and Cyaniding Cripple Creek Sulpho-telluride Gold Ores (88204 D). A. L. Blomfield, and M. J. Trott. Ills. 14 pp. A I M E, Bul—Aug., 1918. Details of roasting furnaces and conditions, etc.

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MISCELLANY

Mines Report

Gild, Silver, Copper, Lead, and Zinc in the Eastern States in 1917 (88059). James M. Hill, with prefatory note by H. D. McCaskey. 10 pp. U S Geol Surv, 1:6—July 29, 1918. Prices, etc.

Prospecting

Hints on Prospecting for a Few Canadian Minerals (88103 N). Wyatt Malcolm. 12 pp. Can Min Inst, Bul—Aug., 1918. Suggestions.

Radium

Radium (88197 D). Richard B. Moore. 17 pp. A I M E, Bul—Aug., 1918. History, ore deposit, treatment, uses, etc.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

Interlocking

Electro - Pneumatic Interlocking Plants (88001). H. A. Wallace. (Abstract.) 4000 w. Ry Sig Engr—Aug., 1918. Details of construction and operation.

Reorganization

Results of Signal Department Reorganization on Rock Island (88102). J. Arthur Hofmann. 1200 w. Ry Age—Aug. 9, 1918. Saving effected.

Signaling

How Motor Cars Can Increase Efficiency (88000). J. Arthur Hofmann. Ills. 1000 w. Ry Sig Engr—Aug., 1918. Results of reorganization of the signal department on the C., R. I. & P.

Duties of a Signal Linesman (88167 N). H. Kirk. 2500 w. Per-Way Instn, Jl—April, 1918. Account of duties and brief description of apparatus in his care.

New Mechanical Plant on Chicago & Alton (87998). Ills. 2500 w. Ry Sig Engr—Aug., 1918. An interlocker on a double-track main line, crossing single-track road, so designed that no night-leverman is required.

Railway Signal Practice on French Lines (87999). J. G. Porter. Ills. 1700 w. Ry Sig Engr—Aug., 1918. Interlocking towers and machines; signaling between stations.

Signals

Position-Light Signals on Pennsylvania Railroad (87803). Ills. 1000 w. Ry Age—July 26, 1918. Use of this type being extended.

Switches

Hand Point Levers (88166 N). F. Treacher. Ills. 6 pp. Per-Way Instn, Jl—April, 1918. Up-to-date fittings now in use in England.

Track Circuits

A Graphical Method of Solving D. C. Track-Circuit Problems (87883 A). H. M. Proud. Read before Instn. Ry. Sig. Engrs. 3500 w. Ry Engr—July, 1918. Serial, 1st part. Reviews previous methods of calculating and explains method devised by author.

Transport

A New System of Transport (87888 A). Frank Dutton. Ills. 3000 w. Engr—June 28, 1918. General review of articles on Road and Rail Transport, appearing in the *South African Railways and Harbours Magazine*.

MOTIVE POWER AND EQUIPMENT

Air Brakes

A 100-Car Test of the Automatic Straight Air Brake (87802). Ills. 3000 w. Ry Age—July 26, 1918. Runs on the Virginian railway to demonstrate the ability of the A. S. A. equipment to handle the longest trains operated under any conditions.

Road Tests of the A. S. A. Brake (88,013 A). Ills. 3500 w. Ry Mech Engr—Aug., 1918. 100-car train run on Virginian with A. S. A. and combination of A. S. A. and Westinghouse brakes.

Test of the Automatic Straight Air Brake on the Virginian Railway (88122 A). Ills. 3300 w. Ry & Loc Eng—Aug., 1918. Recent tests which have shown the possibilities of the air brake for rapidity and reliability of action.

Boiler Repairs

Running Repairs of Locomotive Boilers, and Approved Methods of Wash-Out of Boilers (88121 A). Ills. 2500 w. Ry & Loc Eng—Aug., 1918. Successful maintenance of locomotive boilers in service.

Brake Control

A Mechanical Brake Control System for Railways (88290 A). Ills. 2500 w. Engr—July 19, 1918. System known as the "Reliostop" is described—a British invention.

Cars

High Capacity Cars are a Narrow Gage Railway in India (88103). Frederick C. Coleman. Ills. 1000 w. Ry Age—Aug. 9, 1918. Details of narrow-gage gondola and box cars for the Kalka Simla Ry.

Special Cars for Transporting Heavy Naval Guns (87936). Ills. 500 w. Ry Age—Aug. 2, 1918. Complete unit is 56 ft. long and will traverse curves with 100 ft. radius.

Electric Locomotives

Torque of Electric Motors as Applied to Electric Locomotives (88125 A). 1800 w. Ry & Loc Eng—Aug., 1918. Serial, 1st part. Considers the individual torque characteristic of three different types of motor.

Electrification

Norfolk & Western Electrification Helping Directly to Win the War (88349). Ills. 2500 w. Elec Ry Jl—Aug. 24, 1918. Helped greatly in the transportation of coal; successful in technical and financial respects.

Electric Railways (88413). 1200 w. Times Engng Supp—July, 1918. Review of present tendency of development of both A C and D C systems.

Tendencies in Electrification (88031). E. A. Palmer. 3500 w. Ry Rev—Aug. 3, 1918. Read before Pacific Coast Ry Club. Résumé of leading projects in the United States.

Equipment

New Consolidation Locomotives and Excursion Cars on the Victorian Railways (87941 A). Ills. 1000 w. Engr—July 5, 1918. Detailed description.

Exhaust Nozzles

Locomotive Exhaust Nozzles (88124 A). Ills. 2000 w. Ry & Loc Eng—Aug., 1918. Construction of nozzles, and their working.

Fuel Saving

Fuel Conservation on the Santa Fé (87,845). Charles F. Parks. 3000 w. Ry Rev—July 27, 1918. Explains methods.

Locomotives

A Three-Cylinder Locomotive (88307 A). Ills. and plate. 500 w. Engr—July 26, 1918. Details of the 3-cylinder coal engine of the Great Northern Ry.

Goods Locomotive for the Victorian Railways (87897 A). Ills. 500 w. Engng—July 5, 1918. Consolidation type for heavy goods traffic.

Pacific and Mikado Type Locomotives for C. B. & Q. (87938). Ills. 1200 w. Ry Age—Aug. 2, 1918. Based on previous designs, with improved details.

PERMANENT WAY AND BUILDINGS

Freight House

Pennsylvania Completes Freight House at Chicago (87937). Ills. 2500 w. Ry Age—Aug. 2, 1918. Two-level type of structure.

Reconstruction

Interesting Reconstruction Work on the Erie (88099). Ills. 2500 w. Ry Age—Aug. 9, 1918. A 35-mile section of double track line in Indiana.

Track Elevation

Illinois Central Rebuilds Early Track Elevation (87801). C. C. Westfall. Ills. 2500 w. Ry Age—July 26, 1918. Street subways constructed in 1893 are being rebuilt under heavy traffic.

Track Work

Labor Saving Appliances in Rail Renewing on the Chicago, Burlington & Quincy Railroad (88295). Ills. 1200 w. Ry Rev—Aug. 17, 1918. Describes a sawing machine, and rail drilling machine used.

Turntables

Construction, Care and Maintenance of Turntables (88123 A). Ills. 2200 w. Ry & Loc Eng—Aug., 1918. Causes of trouble and remedies.

Waterloo Station

Waterloo Station (88420). 1100 w. Times Engng Supp—July, 1918. Progress of improvements recently started in this great London railway terminal.

Yards

15000-Car Hump Yard Near Chicago Planned by Illinois Central Railroad (88246 A). Ills. 2500 w. Eng News-Rec—Aug. 15, 1918. Terminal for main-line trains, from which transfer trains will serve local yards. Details of operation.

ROADS AND PROJECTS

Alaska

Government Railroad Building in Alaska (88114). William C. Edes. 3000 w. Ry Rev—Aug. 10, 1918. Review of the enterprises and general history of the work. Address to Pacific Coast Ry. Cb.

Australia

The Trans-Australian Railway (88,289 A). Map. 2500 w. Engr—July 19, 1918. Serial, 1st part. Information from a souvenir volume prepared for the opening ceremony on Nov. 12, 1917.

China

British Engineering Enterprise and Chinese Railways (88395 A). 3300 w. Engng—July 26, 1918. Deals with the Chinese Government Railways, built with British money.

Mexico

The Serious Condition of the Railways in Mexico (88250). 2500 w. Ry Age—Aug. 16, 1918. Report of Latin-American Division of Bureau of Foreign and Domestic Commerce. Conditions changing rapidly and some reconstruction work in progress.

TRAFFIC

Traffic Service

Position of the Traffic Man in the Present Crisis (88115). F. E. Scott. Read before Pacific Ry. Co. 2200 w. Ry Rev—Aug. 10, 1918. Scope of the work.

INDUSTRIAL MANAGEMENT
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Management—The Solution of the Shipbuilding Problem

By W. L. Churchill

The shipbuilding problem is to build and deliver merchant ships. The United States is not building these ships as fast as they must be built, nor as fast as they can be built with the present yards, equipment and working force. This article is based upon a careful study of the work being done in over twenty yards and points out the solution of the problem. Briefly, this is to put into effect the principles and methods of management that have been developed during the last twenty-five years, and which are perfectly well known in other industries.

Mr. W. L. Churchill *has had an extensive experience in manufacturing and industrial management, including the positions of installation engineer and department manager of a firm building conveyor apparatus, later as designer and mechanical engineer on automatic conveying machinery, followed by three years' experience as superintendent of manufacture. From 1906 to 1908 he was superintendent of rates for the Yale & Towne Manufacturing Company. Since that time he has specialized as a professional consulting and operating engineer dealing with problems of industrial management. During the past nine months he has been engaged on a study of shipyard operation problems for the Emergency Fleet Corporation under direction of the firm of industrial engineers of C. E. Knoeppel & Co., Inc.*

THE Critical Need of the Hour Is Ships.

Through the recent drafting of 14,000,000 men from 18 to 45, and the raising of $6,000,000,000 through the Fourth Liberty Loan, we have mobilized our man power and our money power that we may assist to the fullest in quickly and decisively giving the Hun the knockout blow.

To place our army of 5,000,000 men in France and to keep them fully supplied with rifles and guns, shot and shell, food and clothing, locomotives and track, trucks and automobiles, aeroplanes and tanks, and the many other supplies of war, is going to require, What?

Ships, more ships and still more ships.

Are we getting the ships?

We are not—that is, not so fast as they can be built—not so fast as they must be built—*not so fast as they will be built when the true situation is appreciated.*

Recent developments at Hog Island indicate that this great yard will not produce this year one-half its scheduled or contemplated tonnage, and that unless conditions can be speedily bettered the actual production will not be much more than one-quarter of that expected.

And this is not the only place where the production schedule is behind. The remedy chiefly sought is "more men." Do we need more men? The *Public Ledger* of Philadelphia of September 18 quotes as follows:

> After a conference with General Crowder today (September 17th), E. H. Hurley, Chairman of Shipping Board, and Charles M. Schwab, Director-General of the Emergency Fleet Corporation, plainly said the labor problem in the shipyards will be made increasingly difficult under the new draft.

The two shipbuilding officers estimated that the shipyards employ 340,000 men, and that 190,000 additional will be needed to keep the building program in full swing.

Should it have been necessary for Chairman Hurley and Director-General Schwab to ask for 190,000 more men? Is not the answer elsewhere? Cannot present shipyard managements be helped to fur-

Apply the well known principles of industrial management to shipbuilding and:

From 200,000 to 300,000 men will be saved for the army or for other essential war industries.

The sum of $1,000,000 a day in wages will be saved for other war purposes.

And, best of all, we will get the much needed ships.

For:

Manage the shipbuilding plants and you will get effective labor; manage the labor and you will get ships.

ther utilize the present labor supply and avoid any large increase to meet the present planned shipbuilding program?

Carefully compiled statistics on steel shipbuilding indicate quite clearly that in certain occupations covering about one-half of the shipbuilding employees, the program at present contemplated can easily be performed with *eighty-five thousand fewer men,* or with the present forces now employed additional production, equivalent to that of *one hundred and fifteen thousand more men* can be realized.

Further, it can be safely stated that without great difficulty and in a reasonable length of time, the present program could be carried on with *one hundred and ten thousand fewer men,* or with the present force now employed additional production equivalent to that of *one hundred and seventy thousand more men* could be realized.

The available statistics cover only about one-half of the men employed in our shipyards and it is a reasonable assumption that the unaccounted for employees are equally ineffectively employed. In this event, there are engaged at present some 200,000 more men than necessary for the work now being done, and we can gain the equivalent added output of employing 250,000 more men without adding to present forces besides *saving over a million dollars a day* in the process.

Who or what is to blame for this situation? The *New York Tribune,* in an editorial on Saturday, September 21, referring to the Hog Island situation, said among other things:

> Here is a problem for eager and militant America. What will we do with it? We must have the ships. We will have the ships, but first apparently the Government will have to come to grips with the labor situation.

Mr. Charles M. Schwab, Director-General of the Emergency Fleet Corporation, defends labor by stating:

> I for one think that the great majority of the workers are putting forth their best efforts. . . . What I say about Hog Island applies to all other shipyards under our direction.

Mr. Schwab is right. Except in isolated instances, it is not altogether a case of "Lacking Labor and Slacking Labor."

A careful study of many shipyards yields this conclusion: Manage the plants and you get labor; manage the labor and you get ships.

In other words, it gets back to the management of shipyards as is evidenced by their varying accomplishments. Troubles at the bottom are but a reflection of failure to solve the problems at the top.

It is a case of lack of management instead of lack of labor; of undeveloped management instead of slacking labor.

What is responsible for this weakness in shipyard management? *Failure to adapt generally to shipbuilding requirements, modern developments in collective and individual management of successful industrial concerns.*

This is largely excusable under the circumstances that in August, 1917, there were only 61 shipyards in the United States with 162 shipways, while today there are 203 shipyards with 1,020 shipways.

Shipyards that have set the pace and indicated possibilities in shipbuilding are entitled to all possible credit for their accomplishments under the existing handicaps.

Not only have the men had to be found for all of these shpways, but managerial organizations have had to be secured and developed, organized and trained. In view of the fact that a large proportion of these 203 shipyards are less than one year old, and that the available material for organizing managerial staffs has had to be tremendously diluted in order to secure even a fractional part of experienced shipbuilding knowledge for all, it can be readily understood why many of the shipyards have proven unequal to the problems that they have had to solve.

It has been extremely unfortunate that these 203 shipyards have been unable to secure even a moderate amount of guidance and direction in helping them to overcome their difficulties and to get on a reasonably effective basis.

Despite the fact that most of these yards are being largely financed by the government, very little in the way of actual direction of their activities or guiding them in the most effective ways for accomplishing their purposes, has been undertaken by the government.

A great deal of aid and assistance looking to the minimizing of certain troubles that might otherwise arise, has been offered and developed along certain staff lines, but little attempt has been made to show the less able plants how they can come up to the performances of better managed plants, thus tending to speed up the activities of all.

Much has been done to rouse the enthusiasm and eagerness of workmen and of owners and managers, in developing a desire to accomplish all asked of them. To a great degree, the effect of this campaign is nullified by the constant interferences and interruptions due to matters beyond the control of the individuals affected, and these again are generally due to lack of knowledge, training or ability on the part of someone or some group "higher up." There is such a vast difference in the effectiveness of the management of different yards, that it is imperative that the first step in coping with this stupendous problem must be a general management and direction whereby all yards will have authoritative and intelligent scrutiny, and the less effective yards will be brought up to a degree of efficiency reasonably approaching that attained by the best of these yards.

Few, if any, of the shipyards have to date embarked on anything that savors of scientific management, nor are they saturated with the refinements that go with prolonged development of modern ideas; consequently, to bring the shipyard managements up to a common standard which will approach the best of the present operated shipyards is not only an easy task, *but is one that can be accomplished in a very short time.*

Next to failure to receive sufficient supplies of the right steel and outfitting equipment, the chief handicap to the less efficient shipbuilding plants today is their lack of knowledge as to what they should do and how they should do it.

Few shipyards know whether they are employing for the different occupations involved in shipbuilding more or less than other shipbuilders operating along the same lines. Each works according to his own best judgment, with the result of a tremendous variation in total output and in output per man employed.

The simple expedient of indicating to each shipyard the minimum number of people per unit of production they should employ for a given performance has not as yet been generally adopted.

Even the less efficient shipyards develop methods along certain lines that are worthy of emulation and adoption in other plants and unquestionably the good practices of the more efficient plants should be adopted by the others.

Few yards have attempted to standardize performances beyond a limited amount of piece work, and still fewer to the extent of such industries as the Bethlehem Steel Company of which Mr. Schwab in the September issue of the *American Magazine,* is quoted as saying:—

> At very great cost we instituted years ago a system which standardized almost every job and every kind of work through-

out the whole establishment. We carefully arrived at how much work of each kind should be accomplished by normal effort. . . .

Should we not have occupational standards in shipbuilding?

OCCUPATIONS	AVERAGE 28 3 rivets per hour		THIRD BEST 38.4 rivets per hour			SECOND BEST 45.3 rivets per hour			BEST 79.5 rivets per hour		
	Men actually employed	Employed per 100 riveters	Employed per 100 riveters	Reduction	Gain	Employed per 100 riveters	Reduction	Gain	Employed per 100 riveters	Reduction	Gain
American riveting crews	5.266	420	420	9,084	12,316	420	13,000	20.760	420	22,000	62,600
Drillers and reamers	3,567	276	202	6 270	8,564	148	10,834	20,124	120	13,220	30,420
Bolters	4,895	370	335	3,046	3,348	266	9,048	12,800	250	10,432	15,456
Plate hangers	1,323	102	60	3.574	6,090	50	4,428	9,048	40	5,280	13.484
Steel workers	3.349	259	200	4,994	6,126	147	9,504	13,608	106	12,980	20,638
Layer-outs and ship fitters	3,716	287	202	7,222	9,358	189	8,320	11,156	128	13.516	21,002
Laborers	3,956	306	102	17,316	28,848	64	20,540	36,766	41	22,516	42,014
Packers, testers, riggers, aerial and crane men	1,266	98	58	3,346	4,182	46	4,346	6,650	32	5,518	9,232
Chippers and caulkers	1,052	81	54	2,264	3.018	52	2,434	3,304	40	3,440	5,180
Welders and burners	659	51	21	2,468	3,920	16	2,880	4,856	13	3,128	5,458
Mold loftsmen	438	34	26	658	812	22	988	1,336	20	1,154	1,630
Steel yard men	902	70	28	3,480	5,568	27	3,560	5,746	22	3,972	6,692
Totals	30,389	2,354	1,708	63,722	92,150	1,447	89,882	146,154	1,232	117,156	233,806
10 per cent attendance increase				18,182	20,000		18,182	20,000		18,182	20,000
1½ per cent women to be added				2,955	3,000		2,955	3,000		2,955	3,000
Totals	30,389	2,354	1.708	84,859	115,150	1,447	111,019	169,154	1,232	138,293	256,806

TABLE SHOWING POSSIBLE CONSERVATION OF MAN POWER IN STEEL SHIPBUILDING OCCUPATIONS BY BRINGING EFFICIENCY OF ALL YARDS UP TO STANDARDS ALREADY ESTABLISHED BY INDIVIDUAL SHIPYARDS

Also by increasing average attendance to 96 per cent of full time and **by increasing proportion of women workers.**
"Reduction" and "Gains" based on estimated 200,000 men now employed in the occupations listed.

It is hardly conceivable that any combination of industrial plants under a common management would permit the individual plants to go along according to their own ideas of how they should conduct their affairs. On the contrary, as soon as one plant develops any feature that is good, it is immediately installed in every plant to which it can profitably apply. This effort to bring all up to the level of the best has been the great force that has given us the American automobile industry.

In a combination of foundries, for instance, as soon as a single plant in the group indicates that molding or core-making or any other occupation included in its activities, can be conducted with a smaller proportionate number of men per unit of output than the other plants are employing, immediately all of the other plants are not only advised but are ordered to adjust their activities to a similar basis. When necessary, experts are sent to instruct and install the improved ideas, methods or practices.

As illustrating what can be done in the shipbuilding industry along these lines alone, and as a first step in solving this big problem that confronts us in our efforts to get out "Ships and More Ships," all shipyards of the United States should immediately be brought up to a reasonably comparable basis as regards the number of men employed per unit of output. The accompanying table with explanations following indicates that a tremendous increase in output from our shipyards is readily and easily attainable, as well as presenting an opportunity for enormous conservation of man power and saving in money, by adopting this very primary step in collective direction and education.

Explanation of the Table—Riveting

Riveting is undoubtedly the most important of the occupations considered, for, although only a fraction over 4 per cent. of the employees engaged in shipbuilding occupations listed are riveters, with their attendant holder-ons, heaters and passers, there is an aggregate of 17.3 per cent. of all of the employees engaged in the operation of riveting ships together.

This group constitutes the largest single group of employees, are the highest paid of any of the larger groups, and the hardest to find with developed skill and ability or to provide in sufficient numbers.

There are four riveting standards given in the table. The first standard of 28.3 rivets per hour represents the average number driven per hour by all of the riveters engaged by the 13 firms whose performance was studied.

The second standard of 38.4 rivets per hour is the average number of rivets driven per hour by the third best record of rivets driven per hour by any of the 13 firms. The standard of 45.3 is the second best average of rivets driven per hour by the riveters of any of the 13. The standard of 79.5 is the best record of any of the 13. This firm, however, employed but a small number of riveters which partially accounts for this high achievement.

Simply bringing the average output of all of the riveters up to the standard of 38.4 per hour would mean increasing the average output of all of our riveters 35.6 per cent. This means that on a basis of 200,000 employees engaged in our steel ship construction occupations, 9,084 men can be released from present forces, or by retaining these men we can have the equivalent added output of what we would secure by adding 12,316 men of equal skill and training to those at present employed.

Bringing the average output of all riveters up to that of the second best performance of any one of the 13 shipyards would enable the release of 13,000 men, or give us an added output equivalent to the addition of 20,760 men, which would increase output of ships fully 60 per cent.

When it is considered that this average of 45.3 rivets per hour is being attained by no extraordinary efforts, but simply by so managing and directing riveting activities that riveters are enabled to work effectively for a larger proportion of their day than is the general practice, it only means educating the managements of the shipyards that are below this figure in regard to the methods adopted by the firms reaching this high output, to enable this standard to be attained as an average in all of the yards of the country.

Adoption of the best figure of nearly 80 rivets per hour as an average to be attained by all of our riveters would mean releasing 22,000 men, or be equivalent to the addition of 62,600 trained men to turn out ships.

This figure, although not an impossibility, would mean an entire change in established methods of managing and operating riveting crews. It would not mean demanding riveters to perform more manual labor than they now perform, but that their work would be subdivided and managed so that they could spend the time at riveting now devoted to other accessory tasks.

Such a radical increase in average output of riveters would be difficult to obtain without the assistance of governmental offices to overcome technical objections and to insure workmen against being penalized by such changes as are here suggested.

Drilling and Reaming

The drilling and reaming occupations employ 11.7 per cent. of the total forces that are the subject of this analysis or 23,400 men of the estimated 200,000 employed in the occupations under consideration.

This means that for each 100 riveters employed, there are 276 men employed at the occupation of drilling and reaming.

Even allowing for the fact that drillers and reamers work in pairs, this means that there is more than one pair of drillers and reamers employed for each riveter.

The third best figure attained by any of the 13 firms listed employs but 202 drillers and reamers per 100 riveters or, in other words, a team for each riveter. Even bringing all plants up to this perfectly reasonable standard would enable a reduction of 6,270 men, or give us added output equivalent to increasing our forces by 8,564 men.

The second best standard reached by any of the 13 firms is 148 drillers and reamers per 100 riveters. If all yards would reach this mark, there would be 10,834 men not needed for present output, or we would gain in output the equivalent of adding 20,124 men to the present working forces. As the plant that establishes this standards reams 100 per cent., it would seem to be a perfectly reasonable standard to be expected of the shipyards as a whole.

One yard employs only 120 drillers and reamers per 100 riveters. This means that we are employing 13,220 more men than would be necessary if all yards were equally as efficient, or that we can secure additional output equivalent to adding 30,420 trained drillers and reamers to our forces.

There is nothing impossible in reaching this standard as drilling and reaming is affected chiefly by accuracy and thoroughness in the preparation of steel.

Bolting

Of the shipyard forces under consideration 16.1 per cent. are employed in the occupation of bolting. This means that of the estimated 200,000 steel shipbuilding employees, 32,200 are assigned to this work. For every 100 riveters there are employed 370 men at bolting.

The third best yard of the 13, employs but 335 bolters per 100 riveters, which means that we are employing 3,046 more men than would be necessary if all yards reached this standard, or that we could get the additional output of 3,348 more trained men.

The second best record of the 13 firms listed employs but 266 bolters per 100 riveters, which means that we are employing 9,048 more men than would be necessary if the average of all plants was equal to this one, or that we could get the equivalent addition in output equal to employing 12,800 trained bolters. The best record given of 250 bolters per 100 riveters indicates that we are employing 10,432 more men than would be necessary if the average of all of our shipyards in this detail was as good, or that we could get the additional output equivalent to employing 32,200 more bolters.

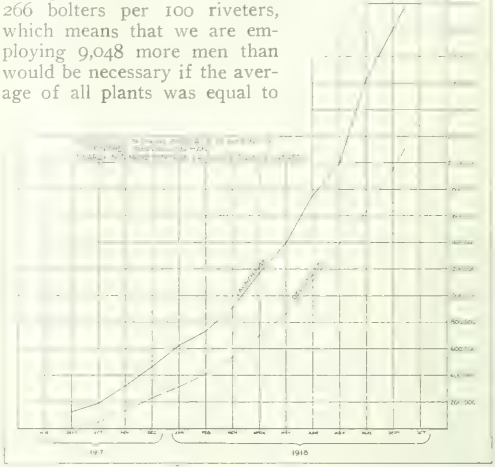


CHART OF ACCUMULATED LAUNCHINGS AND DELIVERIES

It is unnecessary and inadvisable to take the time of the reader to study and consider the detail figures for the other major shipbuilding trades—ship-fitting including laying out, plate hanging, steel working, chipping and caulking, welding and burning, laboring work and for the packers, testers, riggers, crane men, steel yard men and mold loftsmen. However, an analysis of the records of these trades from the same 13 yards reveals a similar opportunity for reductions in the number of men now employed for the same amount of work now produced, or for a decided increase in output per man from the present number.

Utilizing Women Workers

Carefully compiled figures of occupations that could properly be filled by women in connection with steel shipbuilding disclose that with the office positions and clerical duties that could be as well or even better handled by women, and the occupations pertaining to the sorting and reclamation of rivets and bolts which are right in line with established precedent in other industries, that a total of 3 per cent. of all of the employees in steel shipbuilding yards should be composed of women.

In the absence of definite figures of the number of women that are employed in shipyards, it is estimated that not over half of this proportion is at present composed of women.

On a basis of this assumption it should be possible to release a force equal to at least 1½ per cent. of the total workers engaged in the steel shipbuilding activities by the introduction of women workers into the offices for clerical positions, and into the occupations of sorting and reclaiming rivets, bolts, etc., and insisting

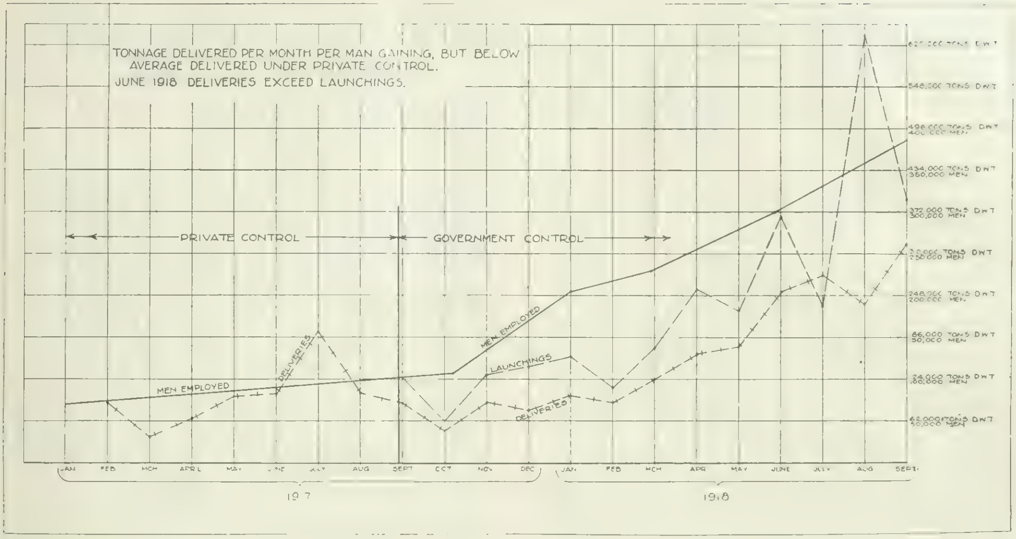


CHART ILLUSTRATING MONTHLY TONNAGE DELIVERED AND LAUNCHED AND NUMBER OF MEN EMPLOYED IN YARDS

upon these occupations being filled by women only.

On a basis of 200,000 employees engaged in the occupations listed in this analysis, insisting upon the introduction of women in their natural occupations would release 2,954 men for other purposes, or be equivalent to finding 3,000 more people for shipbuilding.

Attendance

The average weekly attendance of the employees of nine of the firms in this list, covering 20,153 employees, equals 41.8 hour per week. This figure is probably representative of the average attendance of ship workers the country over, or, if anything, slightly better than such average.

Two of the firms listed have an average of attendance of 46 hours per week or better, and by having all shipbuilding firms build up their average of attendance to such a figure would be equivalent to adding 20,000 people to the present estimated forces of 200,000 shipbuilding employees or enable a reduction of 18,182 from present forces to be used for other purposes.

Totals

On a basis of there being 200,000 people at present employed in the occupations listed in this analysis, simply bringing the efficiency of all shipyards up to the standards reached by the third best in each of the occupations listed, will enable a reduction of 63,722 men from the present force of workers or give us the equivalent of 92,150 added employees to increase output of ships.

Adding to these totals, the effect of bringing the attendance of employees up to a reasonable point, and the introduction of women to the extent of 1½ per cent. more than are now employed, would effect a reduction of 84,859 people, or give us additional working capacity equal to the adding of 115,150 men to the present estimated forces of 200,000 engaged on these occupations.

Bringing the efficiency up to that of the second best calculated would effect a reduction of 111,018 people, or give us the additional working capacity equivalent to the adding of 169,154 men to the present estimated forces engaged on these occupations.

Proofs

As evidence that the estimated improvement in man power attainable by simply directing shipyards in regard to methods to use and people to employ, based on comparing results achieved by different shipyards, can be readily accomplished to the extent indicated at least by the conservative figure represented in using the third best performances of each, it only needs to be cited that two of the 13 firms listed in the comparison are already doing better than this standard while a third firm is very close to it, despite the fact that their efficiency on the individual operations varies between wide limits.

The ouput per man engaged in shipbuilding occupations previous to the shipyards being taken over by the Emergency Fleet Corporation was greater than has been the average output since that date. Simply bringing the average output up to its pre-Emergency Fleet basis, should not be an especially difficult task.

As further proof of the perfectly reasonable expected improvement by a course of education and direction of the management along the lines indicated can be cited the statement quoted in the *Emergency Fleet News* of August 2, 1918, as coming from Mr. H. C. Seaborn, Vice President of Skinner & Eddy Corporation in a letter to Mr. Daniel H. Cox, Manager Division of Steel Construction, as follows:

> -The Skinner & Eddy Corporation which has led all others in the delivery of contract ships to date according to Mr. Seaborn, has produced a little in excess of ⅛ of one ton per man per day for the year. At that rate, it would require only 225 steel ways in the United States to produce approximately 10,000,000 D. W. T. per year and only 250,000 men for these 225 ways.

The September 22 report of the Emergency Fleet Corporation shows that on September 1, 1918, 410 steel ways were completed. According to Mr. Seaborn's figures these ways should produce 18,223,000 d.w.t. in a year and require but 455,500 men.

At the present time, there is a total of 386,000 men employed in all of our shipyards in an effort to reach 3,000,000 tons of delivered ships this year.

From these figures it is quite apparent that we can gain the equivalent of at least 115,000 men in the present estimated forces of 200,000 men employed in the direct ship construction occupations, by a little plain, practical administration. Undoubtedly the other 186,000 employees unaccounted for in the listed occupations are equaly ineffectively employed, and can be brought up to a similar degree of efficiency, enabling us to gain the equivalent of at least 200,000 men by better employment of the 386,000 now engaged in shipbuilding operations.

The possibility of bringing these figures up to 300,000 is not at all remote. It simply means a more intensive application of demonstrated plans and methods to yards not already employing them.

Financial Importance

With the need of more ships and of more men to build the ships, finding the equivalent of these additional men by increasing the effectiveness of the people at present employed, through direction of the management, would be equivalent to saving to the country the wages that will otherwise have to be paid to some 200,000 to 300,000 men to get the same amount of increased output as can be effected by such educational methods, and quickly.

Estimating only $100.00 per month for shipyard employees as average of the earnings of ship workers will mean that the adoption of such measures of tuning up the effectiveness of ship workers will be equivalent to saving the people of the United States from $20,000,000.00 to $30,000,000.00 per month, $300,000,000,00 per year or $1,000,000,00 per day.

Urgency.

To produce even 8,000,000 tons of shipping in 1919, it will be necessary for us to average nearly 700,000 tons per month during that year. Slightly over one-half of this amount has been delivered by us in any one single month thus far.

To deliver 8,000,000 tons in 1919, means practically doubling present working forces or increasing the effectiveness of the men now employed. Accepting "management" as the solution will make it unnecessary for us to add these enormous numbers to our shipbuilding employees.

The adoption of sensible, practical plans that have been demonstrated as effective for the purpose of conservation of man power in industrial combinations, along with intensive plant management development, will enable us to avoid the necessity of adding 200,000 to 300,000 men to our shipbuilding forces and still enable us to secure the contemplated production.

This means that this large number of people will be available for military or other purposes, and as the means for bringing about this conservation of man power is in our hands, we should lose no time in putting it to effective use.

Conclusion

Labor is ready to do its part.

Management must get into line.

Management (collective and individual) can give us the needed shipping tonnage.

Management can save us a million dollars a day while giving us our needed shipping.

Management can leave free for military and other vital purposes an army of 200,000 to 300,000 men and still give us the ships we need with which to deliver the knockout blow to the HUN.

Management will enable us to produce more shipping per man employed than any other nation; thus putting us on a basis for "after war" competition as well as enabling us to be the greatest shipbuilding nation during war times.

Report on Automatic Heat Control

THERE are many appliances on the market for securing automatic temperature regulation. We may state, therefore, that automatic temperature regulation is a commercial success, and that the various methods of securing it are effective.

All devices for automatic temperature regulation are and must be devices making for economy of fuel, since they shut off the heat supply whenever the desired temperature has been attained, turning it on again only when the temperature drops below the desired point.

In all buildings or enclosed spaces, regardless of outside temperature, there will be some heat given off from the bodies of the occupants, from processes carried on, or from the sun. Unless very careful and unremitting attention is given by some person to any system of manual temperature control, these additional supplies of heat will cause an undesirable temperature increase.

In considering temperature in its bearing on human activities and comfort, we cannot lose sight of humidity, as the two are most intimately correlated. So rapid are the changes in humidity following existing methods of varying it, that manual control is impossible.

The cost of heating buildings from an outside source, especially when steam is used, is nearly always reduced by installing automatic temperature regulation.

Costs

The cost of installing automatic temperature control to an existing plant varies, of course, with the conditions. In manufacturing buildings, it is often possible to control a large number of heating units in the same room with one thermostat.

It may be roughly stated that a good system of automatic regulation may be installed in a building for from 5 to 10 per cent. of the cost of the heating plant.

Conclusions

The installation of automatic temperature regulation is a justifiable investment for all heating systems inasmuch as it very positively contributes to:

1. Conservation of fuel.
2. Improvement in health.
3. Gain in personal efficiency.

Those installations in which it is particularly a desirable and wise addition are:

1. All manufacturing plants in which a temperature of 60 deg. or higher is maintained.
2. All offices.
3. All residences. For the smaller residences the type which has but one thermostat, operating on the heater drafts, give excellent results.
4. All buildings heated from central stations, and particularly those having steam service. For many of these the single unit type of control is ample.
5. All buildings having mechanical ventilation. The air changes are so rapid and involve such quick temperature fluctuations that automatic temperature regulation is imperative from the comfort standpoint as well as for many other reasons.
6. All service hot water heaters, particularly those having coils which are supplied with steam. The savings to be made are very great. Prevention of scalding is positive. Steam supply to the coils, or the drafts of the coal fired heater, or the supply to the gas fired heater may be controlled by automatic devices limiting the temperature of the water.
7. All manufacturing processes in which the exact control of the moisture contained in the air and the temperature of any of the materials are of importance.

American Society of Heating and Ventilating Engineers.

Fundamental Factors in Sound Industrial Relations

By H. T. Waller

The author has adopted a rather unusual method of pointing out facts that are essential to an understanding between employers and employees, and as a basis for the working out of their mutual interests. He takes up seven factors and each is illustrated by a cartoon that interprets the vital truth that the accompanying text teaches. Executives may find herein something that can be put into use in their own departments.

Mr. H. T. Waller *was for twelve years a Y. M. C. A. Secretary in Cambridge, Massachusetts, and Akron, Ohio, and became particularly interested in the broader phases of the work of fostering Americanism. For the past two years he has been director of the Bureau of Education of the B. F. Goodrich Company, and has intensely studied the problems connected with the relationships of employer, employee and the community.*

INTRODUCTION

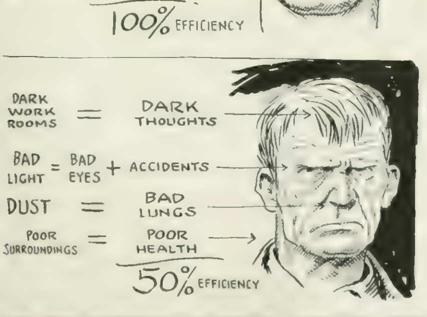
"We hold these truths to be self-evident: that all men are created equal; that they are endowed by their creator with certain inalienable rights; that among these are life, liberty and the *pursuit of happiness.*"

These familiar words of the Declaration of Independence have been so oft repeated that we have failed to recognize the very significant meaning of the words, "pursuit of happiness," at least the application of them has been all too long deferred to far as the great mass of laborers is concerned.

The writer has been in close touch with various groups of society for many years, and counts among his close associates and friends representatives of all classes and conditions of men. The point of contact with various industries of the Nation has given an opportunity for drawing certain conclusions which to the reader may seem trite, for it is quite certain that nothing particularly new is offered in the succeeding pages. There is, however, a very definite purpose which is sought to be establishd in this, paper viz., that there must be a coördination of various factors which vitally affect the relations of employer and employee, that the doing of some one or two phases of "welfare" work does not by any means solve the fundamental problem, but on the contrary is simply a court-plaster that covers the real danger or need that exists, because of the conviction that no one piece of work however good would meet the present crisis in industrial and national life.

The writer has sought to call attention to facts *all* of which are essential in order to establish an understanding between capital and labor making possible the "pursuit of happiness," because of that coöperation between industry, the community, and the individual which will result in a healthy, loyal, and intelligent citizenship capable of enjoying those inherent rights set forth by the founders of our nation. To this end there is set forth a discussion of seven vital principles in their relative order of importance.

The line cuts illustrating each chapter deserve more than passing attention by the reader. They are made by Mr. William Ireland of Columbus, Ohio, who has demonstrated time and time again


GOOD WORKING CONDITIONS = BRIGHTNESS HERE
GOOD LIGHT = CLEAR EYES
CLEAR AIR = GOOD LUNGS
GOOD SURROUNDINGS = GOOD HEALTH
100% EFFICIENCY
DARK WORK ROOMS = DARK THOUGHTS
BAD LIGHT = BAD EYES + ACCIDENTS
DUST = BAD LUNGS
POOR SURROUNDINGS = POOR HEALTH
50% EFFICIENCY

THE BASIC IMPORTANCE OF PHYSICAL CONDITIONS UNDER WHICH MEN WORK

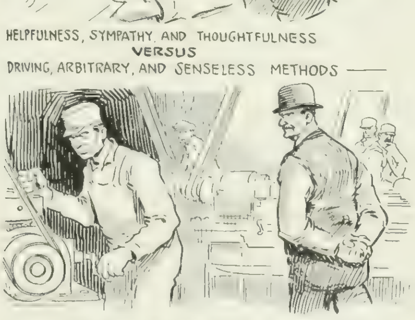

HELPFULNESS, SYMPATHY AND THOUGHTFULNESS
VERSUS
DRIVING, ARBITRARY, AND SENSELESS METHODS

ILLUSTRATION OF TWO KINDS OF SUPERVISION his ability to interpret great vital truths with his pencil. If these suggestions seem to have any value in them they should be put to the test at once.

1. Physical Conditions Within the Plant

A careful study of the labor turnover in certain departments, and personal contact with large numbers of individuals leaving certain types of work indicates that the biggest fundamental influence in connection with any work is the physical condition under which the worker must render his service.

The words, "Too dirty like hell" are ungrammatical and not particularly edifying, but they are surely gripping and indicate the mental attitude of the rank and file toward conditions that are bad physically and react negatively mentally. Modern factory buildings are built on different lines than those of even five or ten years ago. An outstanding fact in connection with this discussion is that for many years little if any regard was paid to the light, heat, or sanitary surroundings in which an employee was asked to work. With the development of education among members of the working class there has come an insistence on their part which has resulted in a change of conditions and, be it said to their credit, some employers of labor have realized the need of this and established better conditions long in advance of others. It has been done because it is good business.

An efficient worker is a much better investment than an inefficient worker, and the time has come when the employer must pay for the bad physical conditions under which men serve by first a tremendous turnover of labor which means loss of efficiency, loss of morale, loss in the quality of product produced, loss in the efficiency of the producer, and above all a loss of intelligent coöperation between the employer and employee. *No amount of supervised welfare work at the top will take care of the inherent needs and rights of men at the bottom. To work men in dust, in dirt, in the dark, for year in and year out is a direct violation of the Declaration of Independence and as well a violation of the fundamental laws of successful production.*

The employee's part: Any building or any machine however essential and efficient may be spoiled by the indifference and carelessness of the employee. The up-keep of any building is dependent upon the attitude of the employees. Their coöperation is highly essential to their own success.

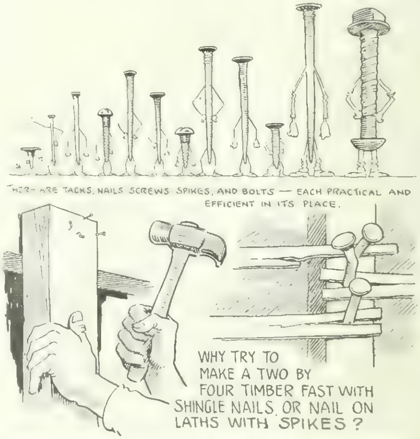
2.—Supervision

The character of "the boss" will decide the kind of product and the stability of the working force providing the physical conditions of the plant are of a high standard. Bosses for the most part are what their names imply. They are drivers of the "fighting" kind rather than leaders of the sympathetic type. For the most part "bosses" have been chosen because of physical attributes. It is not implied that these men do not choose the opportunity of development provided a definite program of instruction is given in order to help them to recognize great present day problems in connection with the handling of labor. A thoughtless and heartless attitude on the part of the man who sets the "pace" does more to undermine the steady flow of production than any one single element outside of physical conditions. *More important is an understanding, intelligent, leadership than technical training or driving power.* Workers will go through hell itself for the man they admire and respect. They will refuse to work, and if they work they will do it in a negligent sort of way for a man they do not respect or admire.

THE TRUE MEANING OF WAGES

The real point of contact between employer and employee, between the corporation and the mass of workers is not the president of the operating committee, the superintendent or the manager nor even in many cases the foreman of a large department, it is the boss, the inspector, the straw-boss, and until this group of real interpreters of the management to the employee come to understand thoroughly the real spirit of the management there can be no real change in the attitude of the employee toward the corporation.

For example, here is a foreman who in the years in which the business was small had been trained by the man who today is the president of the company. The company has increased in size and the foreman no longer comes in contact with the man who was his superintendent and is now president. In the old days the president was a driver, a man who was kind and intelligent with his dealing with men but a taskmaster. With the development of years there has come a change of attitude on the part of the great leaders of industry and this president, together with others, has changed his attitude in the way of handling employees due largely to his contact with influences outside his own particular plant. The foreman, however, has not come in touch with these ideas and with individuals advocating them, and he still adheres to the old idea and in fact believes that he is interpreting his old boss's real desire.


THERE ARE TACKS, NAILS SCREWS SPIKES, AND BOLTS — EACH PRACTICAL AND EFFICIENT IN ITS PLACE.
WHY TRY TO MAKE A TWO BY FOUR TIMBER FAST WITH SHINGLE NAILS, OR NAIL ON LATHS WITH SPIKES?

DETERMINING THE PLACE WHERE A MAN SHALL WORK

The only thing to counteract this is a consistent educational program that will result in every boss becoming a student of the handling of labor, and recognizing that it is as much a part of his business to prevent the turnover as it is to keep his production up to the standard established.

The employee's part: Given a kind but firm supervision this can only remain permanent by the coöperativeness of the employee. It is granted that the first step is up to the foreman, but advancement can only result by openness of mind and a willingness to follow leadership on the part of the employee in order to secure right results.

3.—Wages

The cry of ages has been for higher wages, but some how higher wages have not stopped the restless shifting of thousands of workers. High wages in one community have drawn men receiving low wages in another community, but at the end of a year the man receiving high wages had as little to his credit, if as much, as the man receiving the low wages. The purchase power of the dollar had decreased to a greater rate than the wage had increased.

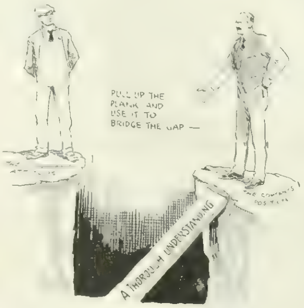
What constitutes good wages? A good wage consists of a sufficient sum as the result of labor to ensure the enjoyment of those inherent rights promised to all citizens by the framers of the Declaration of Independence. To make possible the "pursuit of happiness" there are many complex influences that come into play. The employer and employee constitute an important part of the community. In the industrial community they constitute a large majority. Increased wages usually result in increased cost of living. Intense industrial activities create large commercial activities with the result that the worker's increased wage is absorbed by the increased cost of food commodities, of real estate and of clothing. An added influence also in this field is that of the social and recreational life of the community and it is an increasing drain upon the pocket-book of the common laborer. A real wage must result to the one who produces for the whole community, and if the commercial interests fail to recognize the rights of the worker to save out of his increased wage, then in self-defense the worker must organize in a coöperative way both in building, growing, and buying.

The employee's part: A real day's work for a real day's wages. In the final, real wages are only possible where labor gives a full return for them. A company may maintain itself for a short time with employee's shirking their responsibility, but finally the character of the product and the amount of the product will determine the real wage. It is up to the employee to render full measure for this wage.

4.—Determining the Place Where a Man Shall Work

The employing system of many companies takes little cognizance of the importance attached to right placement. Altogether too long industry has failed to recognize the tremendous loss sustained by seeking to fill physically, positions for which men are needed. If a department requires 15 men, 15 men are shot through to this department, and the next day another 15 men are shot through to this department, and so on day after day and year after year men are shot through both literally and figuratively. What does it mean? Loss to industry, loss to society, and perhaps that which is most important of all a break-down of spirit and morale on the part of the workers. For once a man begins to shift from one job to another it will take some great and powerful influence to prevent him from being an everlasting floater on society. More time should be taken in hiring which would result in less time taken in firing. Physically filling a position with a man does not meet the requirements. The attempt to put a round block into a square hole would fail to stop a leak. Our industries are full of misplaced men.

The productionist says, "send me men and more men," much as the feeder of a threshing machine calls for shock after shock of the wheat in order that he may feed it into the thresher. He cares not what becomes of it if only plenty is provided with which to feed the whirling machine.



MUTUAL UNDERSTANDING.

Employing agents must in order to be efficient be thoroughly cognizant with every type of work for which they do the choosing of men. There must equally be a keen and sympathetic study of human nature. They must be in a most hearty and close coöperation with the foreman of the departments in order to be able to understand whether the man that they are choosing for this department is temperamentally in accord with the man for whom chosen. The Employment agent should be able to adjust these men and by a system of follow-up should be able to ascertain whether the man is accomplishing the thing for which he was employed, and if not, instead of being fired he should place him where he could do the thing for which he is particuuarly fitted. In other words there are certain places where a tack is most useful. There are other places where it would be absolutely of no value and worse than useless. The great problem is to find out what a man is best fitted to do and then fit that man in the best way to do the service he is to render. There is a value to every man.

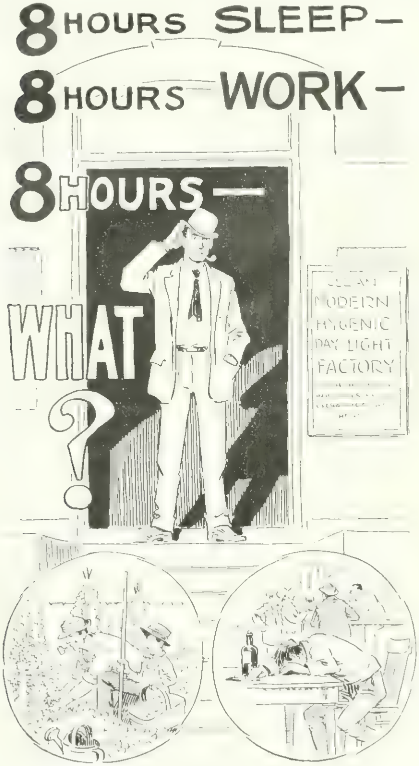
The employee's part: Many a man is placed in a position simply for trial. It is up to the employee to demonstrate his fitness for a better position by meeting the requirements of his present position in a way that would justify promotion.

5.—Mutual Understanding

Most of the dissension between individuals and between groups of individuals is due to the lack of understanding and a common point of view. The employer has one point of view of the work which his employee should accomplish. The employee on the other hand views the situation from a different angle with the result that in many cases there is ill-feeling and strife. The previous four chapters have dealt with matters which are of fundamental importance; no one of them can be disregarded. In a way this chapter on mutual understanding and the two chapters to follow are interrelated and logically follow the previous principles laid down. Yet so important is this thought that it is considered of sufficient value to cause careful consideration.

The I. W. W. movement would have been practically impossible had there been a common language between the employer and the employee. Disregard of the foreign-speaking elements engaged in our industries has resulted in an almost spontaneous revolt against existing conditions. The same holds true of a very large percentage of ignorant American workmen.

A definite program of education, education of the foreman, education of the American, education of the foreigner, along practical lines immediately affecting the relationship of the employer and employee will do much to prevent anarchism, and will on the contrary create an understanding which will result in coöperation and loyalty the only sound basis upon which these two important facts can be realized. Coöperation can only result from understanding; loyalty can only be secured where all the cards lie on the table and there is a common interest recognized by all and a common objective worked for by all. This country is facing the test of democracy. Democracy can only win by the application of the same spirit of equality in the labor world as in the political world.


8 HOURS SLEEP—
8 HOURS WORK—
8 HOURS—
WHAT ?!
CLEAN MODERN HYGENIC DAY LIGHT FACTORY

THE INFLUENCE OF COMMUNITY ENVIRONMENT

The employee's part: Confidence is the basis of respect. No understanding can be reached between employer and employee so long as the employee holds an attitude of suspicion. Therefore, when the good intentions of the employer are shown it is surely up to the employee to render every bit of help to establish a better feeling.

6.—Community Influences

It was only a few years ago that many employers of labor utterly disregarded the influence of the community upon production, and the industry's influence upon the community. It has been commonly said that industry had nothing to do with the community, that all that was required was a certain number of hours of employment and the rest of the time it mattered little to the employer what happened.

A close study of a man's spare time will indicate the tremendous weight that the manner of spending that time has upon the production of any given plant. The economic waste of destructive hours while out of employment is tremendous, and while we have not yet been able to measure in dollars and cents just the amount of this waste, it is self-evident that attention paid to this field would result in larger efficiency in production in much the same way that investigation of machine production has resulted in its advance.

PRESENT AND FUTURE PROTECTION

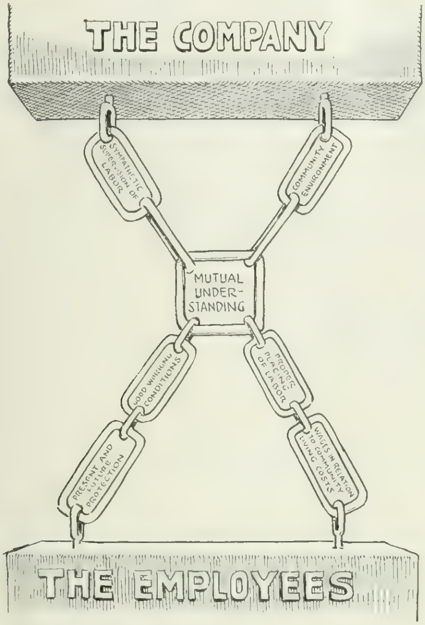
Industry is in many instances the largest tax-payer of the community. It should, therefore, be insistent that its money is expended in such a way as to react to the best advantage of the worker. Then, too, if a community provides good recreational facilities for its people; if its schools are of a high type; if its morals are clean; if its advantages for home-making are high; that community will call to it the best type of working people, and there will be established in the community a permanent home-making constituency. This home-making constituency constitutes the back-bone of any industry. Dissensions and misunderstandings may come and go, but if there is an established group in any community upon which industry may depend, then the permanency of that industry is assured and the best interests of all are conserved. Industry cannot exist independent of the best interests of the community, neither can the community thrive without having the coöperativeness of industry.

Determine the way in which young men and girls spend their spare time and you determine the gauge of the product that is turned out by industrial organization.

The employee's part: The worker holds as much influence as far as his vote in the community as does his employer. It is up to the worker as well as the employer to promote the right type of social, moral, and educational environment in the community in which he lives.

7.—Present and Future Protection

The conservation of health or the prevention of illness constitutes one of the biggest problems faced by all industries. Prevention of anxiety on the part of workers means a tremendous step toward safety and good feeling and efficiency of production. Showing the way of health, the processes of development both physical and mental, is one of those fundamental things essential to the best interests of the workers, and that which is to the best interest of the worker is to the best interest of the employer.



THE LINKS OF INDUSTRY

Therefore, life insurance is a most excellent thing. It is not a charity. It is a recognition of service rendered. Service annuities is a valuable incentive but it should never be necessary because of previous lack of sufficient wage. Sick and accident compensation meet a real need, but only in hastening the day when the worker realizes the results of a full day's pay.

All these agencies are practical illustrations of the "team work" spirit so vital to the life of society. They are all aids to making possible the pursuit of happiness.

The employee's part: Present and future protection is surely a vital interest to the employee, and in addition to that which is extended to the employee there should come the everlasting thinking of every employee in order to promote safety and in order to care for his own family's future.

Conclusion

We have thus seen that there are seven vital principles underlying the sound relationship of employer and employee; that these constitute a chain each link of which is vital to thorough understanding, continued coöperation, and a lasting loyalty.

Disregard of any of these links means failing to round out all elements essential to the best interests of society, and after all, the object of any industry must in the last analysis be to serve the best interests of society and the people that it employs, and the object of every employee must be to make his best contribution to society through the agency of the company that employs him.

There is an inter-relationship existing which necessitates the care and protection of the interests of all and where these interests are disregarded or injured in a single instance it affects directly or indirectly the best interests of the entire group.

Fundamentally the whole is a problem of education to be worked out step by step.

Engineers in this field of human endeavor are as vital to efficient production as the chief engineers of the mechanical plant.

* * * *

Grenades

THE War Department authorizes the following:—

Hand grenades of four types are now being produced at the rate of 2,000,000 a month, it is announced by the Ordnance Department. Within the next four months this rate will be doubled.

Rifle grenades are being produced at the rate of about 1,000,000 a month, and this rate will be multiplied appreciably within the next six months.

Orders have been placed for more than 60,000,000 rifle and hand grenades, and more than 18,000 persons are employed in plants throughout the country engaged in making them.

Based on the method of firing there are two general classes of grenades, namely, hand and rifle. The hand grenade may be of the defensive, the offensive or of the chemical type, of which latter there are two classes, phosphorus and gas.

The defensive grenade is the most powerful and the one generally used when tactical conditions permit, being thrown from cover at an advancing foe. It is about the same size and shape as a very large lemon with a body or shell of gray cast iron scored with deep grooves longitudinally and transversely to insure proper fragmentation when it explodes.

In addition to the body, the main parts of the grenade are: the *bouchon* assembly, detonator and explosive mixture.

The *bouchon* is a die-casting, composed of a tube which is screwed into the end of the grenade body, and a projecting head. The tube holds a standard fuse and detonator which are inserted into the lower (inside) end, so as to bring the primed end of the fuse flush with the upper end of the tube. The projecting head consists of a cylindrical seat with four small lugs on the inside, which hold the priming cap in place over the primed end of the fuse, and a casing which contains the firing spring and the striker. These last are hinged on a pin inserted through two holes cast in the sides of the casing, and are so placed that the spring, when released, will drive the striker against the primer.

The spring and striker are kept cocked by an operating lever, which hooks over the side of the casing opposite that through which the hinge-pin is inserted. This lever caps the casing, and extends down along the outside of the grenade body. It is held in place by a safety pin with a ring attached to it, which passes through the sides of the casing. The small opening underneath the operating lever is closed by a sheet metal sealer.

The grenade is safe till the operating lever is released. Even after the safety pin is removed the grenade cannot function as long as the lever is held against the body of the grenade by the hand of the thrower. In other words, the firing-spring cannot operate until the grenade is thrown. The normal time for the burning of the fuse (that is, the time which elapses between the throwing of the grenade and its explosion) is 5 seconds.

The Human Factor in Task Setting

Problem of Finding Out How Much to Add to the Time Needed To Obtain the Time Allowed

By W. E. Camp

In task work, allowance for the human factor is figured as a percentage of the time needed, and has been found to fall between 10 and 50 per cent. In this article the author enumerates the chief conditions that affect the human factor, shows how they are evaluated and proves that it is possible to pre-determine the proper allowance by giving records of the performances of various operators on various jobs.

Mr. W. E. Camp received his technical training at Yale University, where he was graduated from the mechanical engineering course in the Sheffield Scientific School. He was engaged in promoting Gantt methods in three of the factories of the Remington Typewriter Company for four years. During part of that time he acted as chief of the engineering department of the Bridgeport works, and had charge of the motion study and task setting. He left the Remington Company early in this year to accept an appointment in the United States Shipping Board to assist in planning the operation of merchant shipping by using Gantt methods.

THAT the task-and-bonus plan as a co-related part of a scheme of management results in decreased costs together with increased wages and content of the worker is now beyond question. Records, simple enough to be understood by the layman, covering a period of years and the work of several hundred operators prove these results. The accomplishment is due to the working out of well formulated principles of scientific management and not to any one "feature" which may be employed. When applied to the practical problems of the shop these principles gather many attendant methods and details, so many perhaps, that they become confused with or obscure the essentials. But among the latter belongs the recognition and study of what may be called the human factor.

The importance of a proper solution of the human factor problem in task setting may not be apparent without a moment's reflection. The major purpose of task-and-bonus work is to decrease manufacturing costs and increase the workers' wages. So the task must not be so small as to prevent cost reduction, neither must it be so large that the worker can exceed it by a wide margin and so have the task lose its significance. Tasks must be both fair and uniform. A man must not loaf one day and hustle the next; nor must one man be compelled to work more strenuously than his neighbor. To set a proper task and obtain the desired result therefrom the human factor must be accurately evaluated.

Whether we are setting tasks, piece work prices or premium rates, we should be dealing first, with a study of methods and motions; second, with as accurate as possible a determination of the time *needed* to do the work, *i. e.*, the sum of the absolute times in which each of the component motions can be performed; and third, the difference between the amount of work we will expect a man to do and the amount of work based simply on the *time needed*.

This difference between what we may ask a man to do and what he might do, were he a machine and not a man, is a part of the problem recognized by Secretary Redfield, when he says in the *New Industrial Day:*

> All about great mills are instruments regulating machinery; means are provided that machines shall not be overstrained, that their product shall be within their power regularly to produce without damage to the machine; we even care lest machines get overheated and, in a true sense lest they get overtired. . . . We protect it (the machine) against dust, we lubricate it, we even let it rest, yet that machine is dead, inert. . . . Until the course we take with our machinery is recognized as of equal application to our men and women workers, we shall not have solved the problem of production.

STATEMENT OF THE PROBLEM IN TASK WORK

Where management has for its keynote the task and the payment of a bonus for accomplishing the task, the human factor is a definite quantity determinable by analysis and experiment. The task is a time allowance for doing a certain amount of work under instructions, in the best methods and under the best conditions at our command. Determining this time allowance involves:

A. Study by analysis and experiment of the methods by which the work may be done.

B. From the analysis the selection of the necessary elements, improvement of them when possible, and a determination of the *time needed* for each element.

C. Adding to the *time needed* for each element the time for the human factor to give the *time allowed* and the synthesis of the elements to give the time allowance for the complete job or task

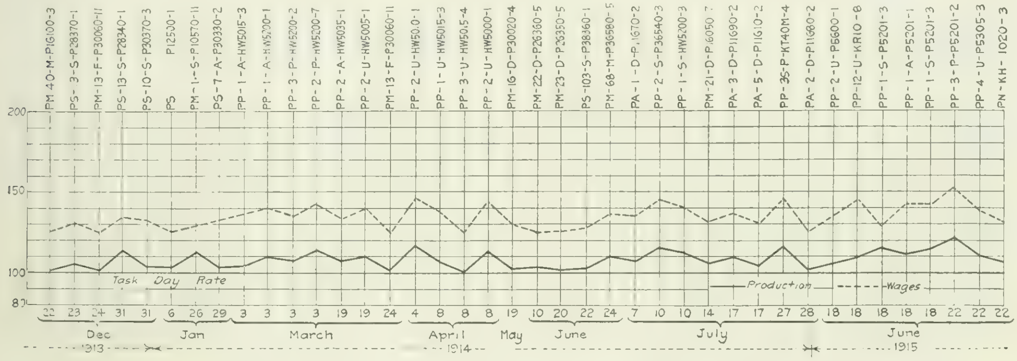
The *time needed* for performing the elementary motions contains no time for rest and delays. The job under investigation is analyzed into elements which are so small that the time for them is very nearly an absolute quantity. To illustrate, it may take a man anywhere from two to three minutes to turn out a piece of work in a lathe, but to make a turn of the chuck wrench takes 0.02 minute by any ordinarily good man anywhere. His location, in New York or Chicago, does not affect the result. In task work the "times needed" for the elements of an operation are so nearly accurate that it would be a physical impossibility for the human body to do nine hours' work in the sum of the "times needed" for the elements of the nine hours' work. It is clear then that the human factor—and rightly so—does not enter into the determination of the *time needed*, but that by adding the correct time for the human factor to the time needed we may get an equitable *time allowed*.

The time for the human factor is solely for rest and such delays as are irregular and cannot be measured. It is not made to cover the ordinary delays in a shop which are caused by the management, and over which the worker has no control. Neither is it made to include elements of the work which occur at intervals during the day, as for instance, tool grinding or oiling machines. Every element of the day's work for which a time value can be determined has its *time needed* and its *time allowed* and becomes a part of the task.

Filling in a time card when finishing a job takes a definite measurable length of time and appears in the synthesis which gives the task. In the case of delays such as breakdowns or failure of power, the worker's "bonus day" is shortened by the length of delay, for which time he is paid at his hourly rate of wages. Such delays cause "time out" as in a football game, and therefore contribute nothing to the setting of the task.

The problem then is to find the proper value for the human factor which shall be strictly the difference between the *time needed* and the *time allowed*.

The importance of this problem will be realized when it is noted that, with all other factors as nearly as possible scientifically correct, the value employed for the human factor governs the fairness of the task. Not only must it be physically possible for a good man to accomplish the task after he has been trained in the methods specified, but the task must be such that he will be able to accomplish it day after day and be contented with his job. The task setter while making a study is frequently "assisted" by a new worker, who gives such information as, "I couldn't keep that up all day." If the task setter knows his business he will reply to the man, "I know it, you won't have to." But he also knows, if he has determined the value of the human factor, exactly what proportion of the day the worker is able and willing to "keep it up." Obviously, if the value employed is too great, allowing the worker to exceed the task by a wide margin, there is danger of the task losing its significance and of losing one of the greatest advantages of the whole plan, namely, the ability to lay out and plan our work in advance. Not only must the tasks be fair to both the worker and the management, but they must be uniform; we do not want a man to "break his neck" one day and loaf the next, nor do we want to ask one man to do more work than we ask of his neighbor. This uniformity can only be attained by the proper solution of the difference between *time needed* and *time allowed*.



TASK PERFORMANCE ON MILLING, DRILLING AND PUNCH-PRESS WORK

Production required by the task and day rate wages are taken as 100 per cent. The symbols at the top are part and operation numbers, etc., and are for convenience in finding data of each job which is kept on file. Some idea of the variety of work represented can be obtained by noting the first two letters of the symbol which denote the department of the shop in which the work is done as: PM, Milling and Drilling Department; PS, Screw Machine Department; PP, Punch Press Department.

CONTRIBUTING CONDITIONS

Chief among the conditions which experience has shown will affect the proper value of the human factor are:

A. Heaviness and general character of the work.
B. The number of pieces of work handled per day, or the number of repetitions per hour.
C. Proportion of idle time while machines are running.
D. Eye or nervous strain involved.
E. Sex of the worker.

In task work the allowance for the human factor is spoken of and figured as a percentage of the time needed, and the proper percentage has been found to vary from 10 to 50 per cent. That is, if we accurately determine that it takes one minute to do a piece of work, we may allow from 1.1 to 1.5 minutes for doing it. In machining small interchangeable parts, the percentage most commonly used is 25 per cent., unless the machine is power fed, when it will be nearer 10 per cent. It is impossible to place a definite value on the general conditions outlined above. We can say roughly, however, that once the proper percentage has been found for a given set of conditions—with particular reference to A above—an exceptional change in either B, C, D or E will affect the proper allowance 5 per cent.

DETERMINING THE VALUE OF THE HUMAN FACTOR

Until a basis of comparison in any class of work has been established the proper allowance for the human factor must be found by experiment. Once a value has been used which gives good results, a study of the contributing conditions will aid us in determining a value for further work. Our experimenting should begin with a clear idea of how much we desire the tasks to be exceeded. There should be no desire to have exactly a day's work accomplished each day, but rather a little better than a day's work. We must leave room for the individuality of the worker, and no matter how uniform our tasks may be, we must have a margin of safety. Let us assume then that we desire to have our tasks exceeded, or "run over" 10 per cent., and that this will be our criterion of the proper value.

The allowance, which is a percentage of the time needed, may be thought of as an allowance of several minutes per hour. For instance, an allowance of 33⅓ per cent. is equivalent to allowing 15 minutes each hour for rest and delays, 45 minutes being the *time needed* for work for which we allow one hour. With this in mind take the specimen case of Pat, who has already informed the task setter that he "couldn't keep that up all day." Pat is filing small castings and after he has been instructed just where to file and how much, it is found that it takes 0.5 of a minute to file each one. We estimate that perhaps 10 minutes each hour should be enough for rest—there should be no delays. Ten minutes each hour is equivalent to a 20 per cent. allowance, so we call our time allowed per casting 0.6 of a minute and the task will be "1 hour per 100." If Pat is paid a bonus of 25 per cent., he will receive pay for 1¼ hours for every 100 he files, providing he does 900 in a 9-hour day. We should like to see him do about 990.

Now we go to Pat and we observe that he can work without interruption for periods of about 15 minutes. We ask him to work steadily for 15 minutes and then to rest for 5 minutes. When the 5 minutes' rest is up, we ask him to work another 15 minutes, to rest 5 more and finally to work for 10 minutes. This completes the hour and upon counting his finished work we find that he has filed 99 or perhaps 101 castings—one hour's work. Incidentally this convinces Pat that he will not be obliged to "keep it up all day." For a few days following this experience we drop around to see Pat occasionally to assure ourselves that the conditions are continuing as they were when the job was studied. We get the proof of whether we have properly reckoned with the human factor when we look at his record and find that he has been filing from say 950 to 1050 castings each day.

After a few experiments like the above, we may begin to weigh the contributing conditions. It will be found that there are numerous jobs with the same conditions as obtained in the one experimented on; that there are many more in which the difference is in only one condition; and that only on an entirely different class of work will we need to use our judgment and test it. Furthermore, as the work progresses our judgment improves and the chance of error becomes less.

PROOF OF THE SOLUTION

That it is possible to determine the proper allowance is proved by the records of performance of various operators on various jobs. The illustration shows a representative chart taken from actual practice, showing the amount by which the tasks on a number of different jobs were exceeded. It was desired to set equitable tasks and to pay a liberal bonus for accomplishing them. The tasks were to be fair enough to the workers to permit them to earn bonus consistently, and fair enough to the management to allow accurate planning of the work in advance. The workers were taught the methods upon which the tasks were based, and were encouraged to "make as much over the tasks" as they could. The result of the 40 jobs charted is shown by the full line giving the percentage by which each task was exceeded. For example, if the task were to perform an operation on a number of pieces in 11 hours and the worker was found to average 10 hours, the point would be plotted at 110 on the chart. The line is not drawn through points taken from one day's work nor in most cases from one run, but is drawn through points representing an average performance after the task has been in operation for a month or more. The dash line represents the increase in wages over day or "straight time" wages.

It will be noted that there were no cases in which the task was exceeded by more than 15 per cent., the average performance for the 40 tasks being nearly 8 per cent. in excess of the tasks. When it is remembered that the aim of the management was to set tasks permitting an excess of 10 per cent., the result proves the elimination of guess work and the use of judgment only when based on analytical data. The determination of the *time needed* must, of course, have been very nearly accurate, but the uniformity could not have been obtained had not the human factor been recognized and treated properly in determining the *time allowed* or task.

The value of a graphical record such as this is twofold: First, as a guide for future work it will point out jobs on which the performance has been abnormal, and reference to reports and data made at the time these jobs were studied will doubtless reveal the error; second, since separate charts are kept of the work of each task setter, the management has an easily readable record of the investigative ability of the task setters.

DISPOSITION OF THE TIME FOR THE HUMAN FACTOR REST PERIODS

If the value of the human factor in a given task were 25 per cent. and the operator were to work for the entire day without rest or interruption, he would exceed the task by 25 per cent. But with varying allowances of from 10 to 50 per cent. the average task is exceeded by not more than 10 per cent. Where does the balance go? How much is taken up by inability to perform each element of the day's work in the time needed to perform it and how much goes into periods when absolutely no work is done? If any considerable amount goes into the former, the workers are poorly trained or improperly instructed. The worker should be trained to work while he works, and rest while he rests.

At some factories the power is shut down for 10 minutes in the middle of the forenoon and 10 minutes in the middle of the afternoon. It has been the experience where these "rest periods" have been inaugurated that they do not decrease the production for the day, but rather that they increase it. The workers are thoroughly in favor of the recess since it enables them to earn more money; legalizing, as it were, rest which they would otherwise take in ways which tend to decrease their earnings. Where rest periods are in force, no difference is made for rest and delays, or in the general method of setting the tasks. The rest period to a large extent controls and enforces the disposition of the time for the human factor.

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Book Notice

Powdered Coal as a Fuel. C. F. Herington. Size 6 x 9 in., 212 pp, illustrated; price, $3. New York: The Van Nostrand Company.

This is one of the latest contributions to the subject which is of increasing importance in industrial use. The qualities of various grades of coal suitable for pulverizing are treated and the processses necessary to render the coal suitable for this kind of combustion are described. The use of powdered coal in cement works and in many metallurgical operations is fully treated and the furnaces, burners and other equipment described and illustrated. There is a short description of its use in locomotives in which application by the way there will undoubtedly be a much greater demand for apparatus of this kind before long, as the results secured on several railroads have been highly satisfactory from the point of view of economy and reliability in service.

* * * *

"We must have an effective army of transportation, an effective army of war industries, an effective army of food and fuel production, and we must have and maintain all the time an effective army for Liberty Loans."—*Hon. Wm. G. McAdoo.*

Effect of Changes on Airplane Output

Manufacturers Must Abandon the Idea of Standardized Production

By An Industrial Engineer

The matter of changes of design in airplanes and airplane engines is an outstanding point of controversy in our aircraft program. America is the home of standardization and quantity production. Why have airplanes not been standardized and produced in vast numbers? This question sums up the popular view. But there are controlling factors that are not so easily seen. The dominant one is the need of the military man. In a forceful manner this factor is presented in this article written by an industrial manager who prefers to remain unknown. He has prepared no defence of what has occurred in airplane manufacture in the past. Rather, he shows to the manufacturer why the set idea of mass production must give way when we are producing a machine that is daily undergoing modifications because of experience gained at the fighting front. More than a good standardized product is demanded—perfection only can be accepted. To reach this end every improvement must be put into effect as soon as it is suggested, and the methods of production must be flexible enough to permit following this course without regard to absolute standardization.

PRIOR to the outbreak of the World War the manufacture of airplanes was conducted on a very small scale. There were airplane factories that thought they were doing a pretty good business if they produced and sold one airplane per year. One machine a month was considered a large production.

The outbreak of the war and realization of the field of usefulness for airplanes stimulated their production, brought about the enlargement of America's airplane factories, and the construction of some new ones; but, except in one or possibly two cases, none of the airplane factory developments were projected on a large scale, and the manufacture in American plane and airplane motor factories was continued on a small jobbing scale.

When the United States entered the war the problem developed into a new phase. An enormous production of airplanes was imperative, to which the business and practice of mass manufacture seemingly had to be applied to realize our military aims. The airplane manufacturers were not versed in the art of mass production and their plants were not suited to it in size, personnel, equipment nor organization.

View of the Automobile Industry

Manufacturers of automobiles, automobile motors and parts were attracted to the airplane industry by the lure of the airplane itself, by their evident adaptability to the work, and by the knowledge that as the war progressed it would be necessary to reduce the output of automobiles. The Government looked with favor upon bringing the automobile manufacturer into the field, because it was obvious that when the rate of manufacture of automobiles should diminish, there would be enormous manufacturing capacities standing idle unless they were inducted into the activity to which they were suited.

The automobile and automobile motor manufacturer having thus been drawn into the airplane manufacturing business, both they and the Government have been confronted by a number of problems that were not appreciated, or at any rate not given their full weight, at the beginning of the war. The problems of the airplane manufacturer have been and are greater and much more difficult to solve than was anticipated. Experimental models were made and later put into production, without the knowledge that the manufacturers now have; the possession of this knowledge a year ago would, of course, have avoided much delay and distress. The manufacturers, and the Government officials connected with aircraft manufacture have done a big work and the time will come when their work will be understood and appreciated.

The Problem of Changes in Design

Leaving aside the difficulty of getting material, of breaking in help to new and extremely accurate work, the spruce problem, the confusion of ideas as to types to be built, etc., it is the purpose of this paper to discuss the effect of changes in design on the rate of production of aircraft, with a view to seeing what the attitude of the manufacturer toward changes of design in machines in production should be. In order to discuss this intelligently, it must be considered from the viewpoints both of the manufacturer and of the user of airplanes.

Automobile manufacturers have been accustomed to long runs, usually at least a year on one model with only minor changes, if any at all. These automobile manufacturers are now manufacturing airplanes. They naturally think, from experience, that they must go in for long runs on airplanes in order to get large production.

Problem of the Military Men

Airplanes are used by military men, and military men are accustomed to make changes in their strategy, tactics, disposition of force, and in material both as to use and kind, in order to meet the varying conditions of warfare in contact with the enemy. The military man is a man just like the manufacturer, and has the same innate opposition to making changes that the manufacturer has; but he has to make changes, and make them promptly, in order to meet new conditions—conditions over which he has no control. It is not exactly right to say that he has *no* control over conditions, because he has normally at least as much control as the enemy; and if he has a greater force at the point of contact, he can dominate. But his complete, or nearly complete control, is, however, limited to short and varying intervals and small areas, and in general it is safe to say that he lacks control.

Thus he has been brought up, so to speak, to change his mind and his requirements on short notice, and military history shows that the military man, better say the general, who can change his mind the quickest with the greatest accuracy under stress is the most successful. Modern military organization is based on de-centralized authority, in order to take advantage of this principle. This is a good doctrine to follow in things industrial.

Sharply Opposed Viewpoints

With the problem recorded from these two antithetical viewpoints, it is fair to question who will win, the manufacturer or the military man. The man who manufactures says, "There shall be no changes"; the man versed in military affairs says, "There must be changes, whenever necessary." To answer the question, shortly, it may be said that the military man will of necessity dominate. He will learn a little bit from the manufacturer, but the manufacturer will learn more from the soldier.

This applies with particular force to the airplane industry, with much greater force, in fact, than to the gun and ammunition manufacturing industries, because the latter two industries are engaged in the production of rather well standardized products, have been through many years of investigation, experimentation, development and use. But the airplane industry is a baby and has a rapid development ahead of it, a development that will surely be as rapid during the remainder of the war as it has been up to today.

The automobile manufacturer in the airplane business must think of the difference between the viewpoint of his present customer and that of his customer of the past. Should an automobile lack hill-climbing or manoeuvering ability, or radius of action, or ability to hold the road, or whatever other attribute, its owner will put up with its deficiencies remembering its good points; he will take its good points and deficiencies into consideration with the price, and then might continue to buy a kind of machine that is obviously not so good as other makes of machines, because it would be good value and meet his requirements.

But if an airplane lacks in speed, climbing ability, manoeuvering ability, radius of action, stability, reliability of motor, etc., flyers—men—are killed, engagements are lost and commanders lose objectives. Here is a different situation entirely.

Automobiles are disposed of by selling talk, advertisements, and by performance taken into consideration with cost. Planes are disposed of on the basis of their performance; cost is of secondary importance, and a poor second at that. The question of cost only enters when the work of the airplane manufacturer is examined to find out whether or not he produced the required model and output with satisfactorily efficient use of labor and material as represented by cost figures.

Just Consider!

To help in the consideration of these two viewpoints, think of two automobiles each operated by an armed driver, the drivers being about to engage in a duel. The automobiles being equal, the more skilful driver and better shot will win, but if the automobiles are of different makes, the problem becomes more complicated. The less skilful operator or poorer shot, might have a machine with greater pick-up, shorter turning radius, etc., and might win.

If an airplane is good except in one or two respects, it is not good enough. In fact if a plane is as good as we know how to make it, and apparently not lacking in any respect, it still is not good enough, not even if it is better than any plane the enemy is using, because in this contest absolute perfection, not comparative excellence, is the aim. If then a plane is deficient in one or more respects, the question is not whether it should be improved; *it must be improved.* The single question is, how quickly can the improvements be brought out?

Now this is not an impossible task, it is only a hard task. It is much harder than it would have been to develop the plane in peace time, and it is much harder than the development of automobiles ever was, even under the stress of commercial competition. Hard as it is, it is essential that the problem be solved, therefore it is necessary that the manufacturers work harder, which is a very simple statement to make, and it is just as true as it is simple, albeit there is certainly great difficulty in carrying it out.

Improvements Must Have Right of Way

In the first place there is no such long time allowable for the experimental development of the airplane as was allowable for the development of the automobile. Once there is conceived an idea for the improvement of a feature of a model, or even for the development of a new model, work should proceed day and night, even without regard to time of day, until that improvement is developed and tried in the air. The parts for the first improvement, it will be expected, will be made from sketch plans and meagre information just sufficient for the engineers and skilled mechanics engaged in the work. But the preparation of the production drawings should be carried on even while the first experimental parts are being made, with the aim of having production drawings ready when the improvement is tested, so that should the improvement be satisfactory the first time, the production drawings might immediately be released.

If not right, and usually it is not right at first, it must be changed and the production drawings should be changed at the same time. Then when the improvement is pronounced satisfactory, plans are ready and the plant can get to work, day and night, producing the new parts with a view to getting the improvement into production at the earliest possible date. This step is to be followed by a normal rate of production of the new part. Coupled with this must be the disposition to discard willingly old parts, that is, parts of superseded features.

Hard as it is to go through this process to change a feature of the model, it is harder to change a model. Nearly always when a model is changed, it is necessary to change all of its parts. To retain old parts in the design might increase weight or reduce the factor of safety, or produce an awkward machine. The 100 per cent. perfect goal is to change over a model without loss or delay in rate of production. This is a dream to be sure, because manufacturers and working men and women are only human and cannot attain perfection; nevertheless that is the thing to keep in view.

Putting the Change Into Production

There are manufacturers who will agree with everything stated in the foregoing and yet will not go far enough, because they will want to have the production drawings exactly right before "putting the change into production." They will want to produce one or two check machines from the production drawings as issued, perhaps even stop to make a wooden model during the preparation of the drawings, in order to make sure that the drawings as released are complete and accurate. This is good business in peace time, but bad business in war time. Putting a new thing into production whether it be an improvement in feature or a change in the model cannot wait to get drawings absolutely perfect or even nearly perfect. The Army is in too big a hurry. To be sure, to put the change into production without this check on production drawings is much more difficult, but it is none the less necessary.

It is not even permissible to wait to make the jigs, fixtures and special tools for the production of the new part or model. These, of course, must be made if a large number of machines are to be brought out, but while they are being made, a force of hand workers must be put to work, making parts by hand while the mass production equipment is being prepared. Thus by the time the production equipment is ready there will be many parts completed, embodying the new idea.

A large plane will have 2,000 or more different kinds of parts, exclusive of the motor, and a change-over by the methods outlined above is a tremendously hard job.

Same Needs Apply to Motor Manufacture

These paragraphs apply with equal force to airplane motor manufacture; and the 1,000 or more changes on the Liberty motor are nothing when regarded from this viewpoint. The industry is much better off on account of having started with the Liberty motor drawings in imperfect shape and with certain development work yet to be done, and there are more motors than there would have been if the country had waited for the completion of the experimental work and production plans. The delay in the production of Liberty motors is, of course, complicated, because this was the first time these manufacturers had produced airplane motors—they were green at it, so to speak. Nevertheless there will again be a great delay when a revised model of the Liberty motor comes out; and then when a motor which is an improvement on the Liberty motor shall come out there will be even greater delay, trials and tribulation, because of imperfection in design and plans. However, if the manufacturers go forward boldly and correct the errors as they come along and keep the work in production, there will be more motors more quickly than if they wait for thoroughly complete drawings.

People's Sympathy Should Be With Manufacturers

These comments throw some light on the difficulties of the problem of plane and motor production. The people's sympathy should be with the manufacturers, and their censure should be reserved.

From time to time the military man must say, he will say, what equipment he is going to use against the enemy. It remains only for the industrial man to say how the military man's wishes shall be met, and how soon.

It has been said so many times as to be trite, that this is an industrial and engineering war. This statement does not even nearly express the whole truth. It is just as difficult a war from the viewpoint of the strategist and military man as any other war; in fact, it is much more difficult, because he has much greater forces to handle and much greater difficulties to meet. The question for the industrial man to consider is, "Where is the American's boasted ability and resourcefulness?"

* * * *

Efficiency and Idleness

By H. L. Gantt

Consulting Engineer

WHAT we have accomplished in our preparations for war and in getting men to the front has surprised ourselves, and apparently satisfied our Allies.

It has been accomplished by the splendid energy and the tremendous resources of the American people, but nobody pretends that we have shown any high degree of efficiency in doing the work. Our expenses have been enormous, and we have reconciled ourselves to this great expense by saying over and over again that nothing counted except winning the war, which in the last analysis is true; but it is also true that excessive expense will not only not help us to win the war, but will in the end hinder us in accomplishing this result.

Is it not time, with our budget mounting higher and higher, for us to look about and see whether it is not possible to accomplish the same results less extravagantly? The way we have fumbled in this war would seem to indicate that the great campaign for efficiency which has been waged so assiduously in this country for the past 20 years, has not accomplished for us all we had led ourselves to believe.

That we have increased individual efficiency and profit-making efficiency, and perhaps other kinds of efficiency, is not to be denied. That we have attained a high degree of national efficiency or a high degree of efficiency in the production of goods, is nowhere indicated. It took the shock of a great war to arouse us and to make us realize that our great prosperity was due to something other than our productive efficiency.

Our Wrong Efficiency Aim

Surely, the campaign for efficiency that has been so assiduously waged for such a long time has been seriously and honestly waged. Why, then, have our results been so meagre? The answer is simple and plain. The aim of our efficiency has not been primarily to produce goods, but to harvest dollars. If we could harvest more dollars by producing fewer goods, we produced the fewer goods. If it happened that we could harvest more dollars by producing more goods, we made an attempt to produce more goods.

The great emergency created by the war is one in which our need is not primarily for dollars, but for goods, and people whose training has been exclusively to seek dollars are in most cases not at all fitted for the production of goods. Those who have been most successful in acquiring dollars are, however, the ones best known as business men, and when it was thought we needed a business administration, such people, with the best intentions in the world, offered their services to the Federal Government, many at a great sacrifice of their own interests. They found, however, that for war we needed goods; dollars were only the means.

Overlooking the Idler

Another phase of the efficiency movement with which we are all so familiar, was the attempt to increase the efficiency of the worker, and to ignore entirely the idler, for according to the system of cost-keeping generally in vogue, that seemed the most profitable thing to do. The case was worse than this, for not only did the system ignore the idler, but it eliminated the inefficient, absolutely ignoring the fact that both the inefficient and the idle were going to continue to live and be supported directly or indirectly by the workers.

The war waked us up to the fact that the world was running short of the necessities of life, and that the product of even the most inefficient was some help. The scheme for the selection of the efficient must now be supplemented by one for forcing the idler to work.

The great difficulty of installing such a system is that the cost-keeping methods in general vogue indicate that such methods are not profitable. In spite of this fact, war emergency is forcing us to adopt them. The only answer to this is that *our cost-keeping methods are fundamentally wrong, and that we shall continue to suffer from inefficiency until they are corrected.* The great error in them is the fact that they absolutely ignore the expense of idleness. As a matter of fact it costs almost as much to be idle as it does to work. This is true whether we consider *man* or *machines*, or, in other words, *labor* or *capital*.

This leads at once to two natural questions:

What is our expense for idle labor?
What is our expense for idle capital?

Manufacturing concerns pretty generally eliminate idle labor as completely as they can, (many times by discharging workmen who could be profitably used if work were planned for them).

They cannot get rid of idle capital so easily, for it is tied up in machines that cannot be sold. The only possible way to eliminate idle capital then is to put it to work. The first step towards putting it to work then is to find out why it is idle. As soon as this is done means for putting it to work begin to suggest themselves. Our cost-keeping system must not content itself with charging all expenses to the product, but must charge only that expense to the product that helped to produce it, and must show the expenses that did not produce anything, and their causes.

Students and Instructors

Packard Training Schools for Employees

Four Schools are Operated: For Men, Women, Instructors for Women, and for Job Setters and Foremen

By D. G. Stanbrough

The factory training school is here to stay. Never again will employees be merely thrown into jobs without any help to show them what to do and how to do it, or without any aid toward advancement. For some years the Packard Motor Car Company has had a training school for men intended to produce skilled workers in certain specialized automobile trades. Owing to the labor conditions of the past year this work has been very greatly extended. Women in large numbers, instructors for women, sub-foremen and foremen are now being taught. It is interesting to note that our experience demonstrates that the direct expense for training a woman employee is a trifle over fifty dollars.

Mr. D. G. Stanbrough *received his early training in a number of machine shops, won a scholarship at Cornell University from one of the New York City Evening High Schools; spent 10 years at the United States Navy Yard, Norfolk, Va., as draftsman, master electrician and shop superintendent, six years of this period being devoted to shop administration. Later he was manager of the truck manufacturing for the Packard Motor Car Company for almost two years and for the past year he has been general superintendent. His specialty is factory administration.*

THE advent of woman into industry and the necessity of giving her some preliminary training before placing her at work in the factory has forcibly brought to the attention of the public the necessity for training rooms and so called vestibule schools. However it should be realized that the principles involved are not new. At the Packard Company we have maintained a training course for years, it being our policy to supplement the supply of labor in any particular trade by training men and women to relieve localized shortages in that trade. We have trained varnishers, varnish and enamel rubbers, body trimmers, and workers in other limited trades particularly adapted to automobile manufacture.

The justification for a training school, regardless of the sex of the employees, has been shown by our labor turnover. A graph plotted from our employment records shows two distinct breaks as follows:

First break between the first and second months of employment.

Second break between the fifth and sixth months of employment.

In other words, at these points the resignations do not follow mathematical laws. An analysis of the above breaks shows the following:

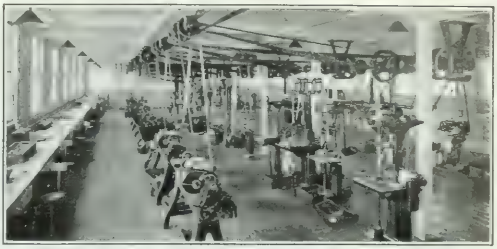
THE FIRST BREAK IN TURNOVER

The first break is the result of the tendency on the part of men to try out one shop after another, with the view of either finding something easy or getting experience in a trade on which they had not previously worked.

To correct this condition we proposed to pass all men of mechanical trades entering our establishment through the school, each man's time in the school being dependent upon his proficiency in the trade in which he claimed experience. This method of procedure made it possible for us to at once get a definite knowledge of a man's ability, from a man competent to judge, and thus localize a large part of the turnover in the school. This practice also afforded an opportunity to weed out the undesirables without taking them into our factory, as the school building was located independent of the factory.

Just as we were getting this method of selection started, we were confronted by the necessity of training women employees to replace men lost through voluntary enlistment or draft and the school equipment was directed to this end. It is just recently that we have been able to go back to our original practice in a small way. Our efforts, however, in training the women have fully convinced us that

WOMEN'S TRAINING SCHOOL—PRELIMINARY INSTRUCTION



EQUIPMENT AND ARRANGEMENT OF WOMEN'S TRAINING SCHOOL

the original plan was correct, and it is believed that the method applied in the training of women can be used in toto in the case of male help.

The Second Break in Turnover

The second break can be traced to the pronounced tendency among a certain class of workers to shift periodically. In this class fall the professional floater and the man who travels from one part of the country to the other following the seasons and working only long enough to obtain a "stake" to move on to the next "pile."

Fundamental Training

It should be understood that, in the case of a plant employing men or women in metal trades, the fundamental knowledge necessary to success is a clear and concise familiarity with measurements and the tools through which measurement is accomplished. All employees, whether employed in assembly work, on a machine, in the stock room, on inspection, welding, core making, etc., use measurements at every turn. It is, therefore, imperative that employees be taken into the shop with a clear and concise knowledge of this important subject. Consequently, as a starting point in our instruction, we developed a series of measurements, progressive in character and covering the entire range found in practice. A new student is supplied with a blue print and a set of pins, the idea being that the pins were to be measured and the results set down on the blue print in the proper place. Thus the student not only gains a knowledge of measurements, but also, obtains experience in reading blue prints through the process of making them. One of the prints of this series is reproduced on page 380. The total time allotted for measurement is 18 hours. The measurements cover the use of a scale, calipers, pitch gages, micrometers, bevel protractors, and final test pieces involving the use of all tools.

From this point, the student is given instruction in the particular trade which he selected as a specialty. In the case of a woman, she has by this time become sufficiently familiar with the work room and seen enough of the various trades employed therein to gain some preference, and, of course, it is realized that success is best obtained through catering to the employment preferences of the employee. A course of instruction is offered on lathes, hand screw machines, milling machines, gear cutters, hand milling machines, sensitive drill presses, multiple and radial drills, tapping machines, tool grinders, external grinders, splining machines, swing lathes, Fox lathes, Potter & Johnson automatics, Lapointe broaching machines, inspection, bench work, major assembly, dynamometer, testing, minor assembly, welding, stock tracing, tool crib tending, soldering, stock room tending, and in figuring premiums. The time required to complete the special training is from seven days in the case of a clerk, to sixteen days in the case of a welder, ten days representing the average time on machine tools.

It was found that it was possible to train one woman per 34 feet of floor space per month, this area including offices, rest rooms, cloak rooms and all space incidental to the work.

A complete record of each student is kept, not only as a student progresses in the school but in regard to her subsequent progress in the shop. The front and reverse sides of such a record are shown on page 380.

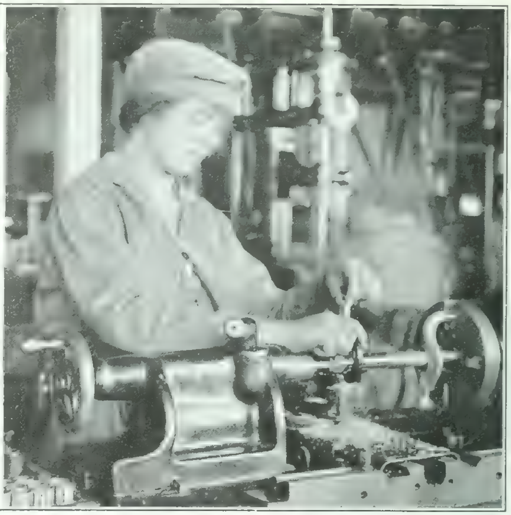
Organization of the School

In organizing a school for women we followed the practice successful in our earlier school. We took one man from the factory who was thoroughly familiar with Packard principles and aims and gave him full authority to develop an organization, insisting, however, that such organization should come from without rather than within and was to be selected from the run of prospective employees who found their way to our employment office. The plan hit upon was for the superintendent to pick men who were good mechanics and give them at first the duty of training women to act as their assistants. The various operations were supervised as follows:

Operations	In general charge	Assistants,		Students under each man in charge	Students under each assistant
	men	women,	men		
Preliminary instruction	1	6			6
Lathe work	1	3			3
Drill presswork	1	2	1		4
Milling machines operation	1	2			4
Grinding	1	1		2	2
Finished inspection	1	2	1	8	6
Bench work	1	2	1	6	6
Assembly work	1	4			3
Welding	2	3	2		4

Of course the success of our school and the responsibility to implant in the students the principles for which our organization stands rests with the instructors. To this end it was necessary to have frequent meetings after hours in the form of lectures in which the instructors were taught Packard principles. It has also been found necessary to run an advance course for instructors where they are given instructions in shop mathematics, and mechanical training similar to that given to apprentices. In order that our instructors might have a broad outlook and be encouraged to take an interest in things mechanical beyond the confines of their daily em-

STUDENT EMPLOYEE OPERATING A MILLING MACHINE



STUDENT OPERATOR USING A MICROMETER

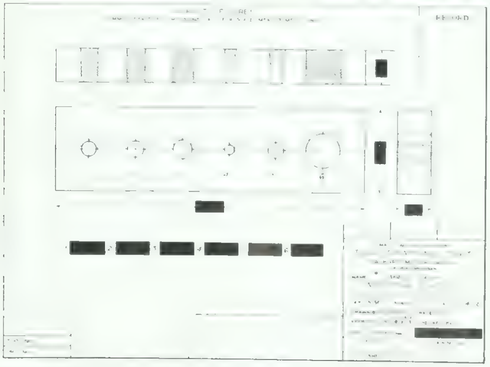
ployment, technical papers are available and instructors are encouraged to read them.

Cost of Operating the School

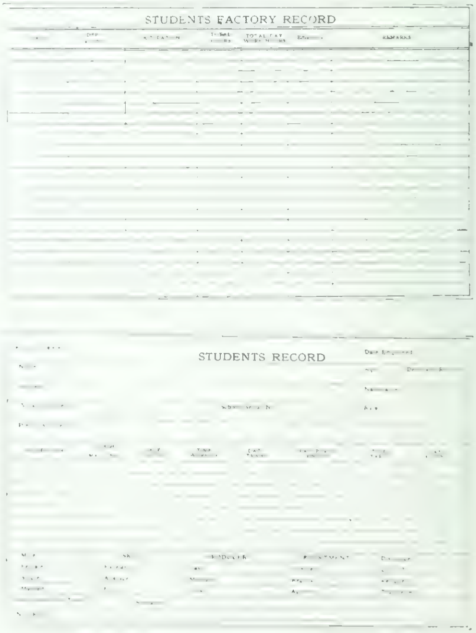
The cost of operating the training school for a typical month is as follows:

Shop supplies	$3,921.08
Hand tools	1,951.73
Repairs to tools and machinery	557.29
Stationery and office supplies	80.15
Inspection and educational expense	6,979.29
Non-productive labor	745.59
Supervision and clerks	3,099.64
Total	$17,334.77
Operators graduated during the month	332
Direct cost per student	$52.21

It should be realized that in a training course good instructors, good tools and clean, light, ventilated work rooms, add materially to the success of the job but do not make it. In dealing with large numbers of employees who have little or no conception of the job in hand, we have noticed a strong tendency toward lack of direction in the efforts of the students, and it has been found that success can only come as a result of strict discipline—you must give practically individual attention to each student, consequently, the instructing force should not be over-burdened. We have found that on elementary work, one instructor can take care of five students, while on machine work 1 to 3 is the outside ratio and 1 to 2 gives the best results. A woman student must be taught:



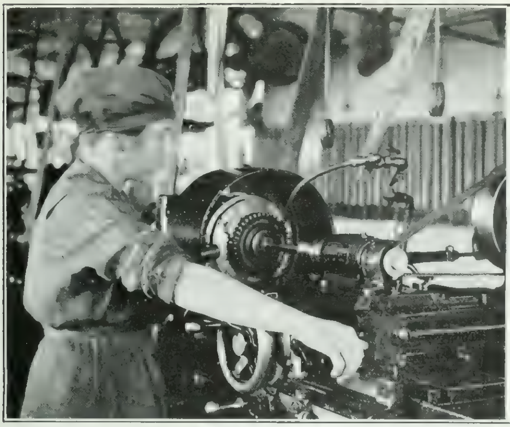
REPRODUCTION OF SPECIMEN BLUEPRINT [illegible] TO [illegible] MEASUREMENTS



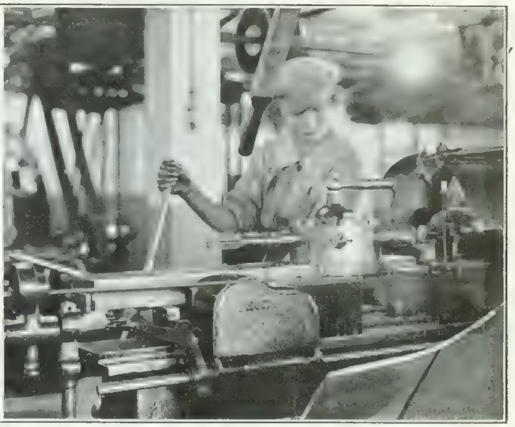
STUDENTS FACTORY RECORD

STUDENTS RECORD

FRONT AND BACK OF CARD FOR SHOWING STUDENTS RECORD



INTERNAL GRINDING WORK



OPERATING A HAND SCREW MACHINE

1.—To keep her efforts on the work.

2.—The proper sitting or standing position, as the case may be.

3.—Uniformity in wearing uniforms, caps and aprons.

4.—Neatness about the benches and machine tools.

5.—Neatness in appearance.

OTHER FEATURES OF THE TRAINING

Each student must be carefully watched for deportment at all times and any tendency toward slackness must be immediately corrected upon being observed. While the strictest discipline may not be necessary for success in the shop, it is absolutely essential to success in school work, as it keeps the students alive at all times to the knowledge that they must make a continuous effort as they are under surveillance; it also develops the weaker tendencies of the individual which would not be desirable in a shop and affords an opportunity to weed out the undesirables.

It should be realized that in the training course, the worker must not only be trained to do the job correctly, but must also be trained physically to do the job easily. We make it a practice to permit sitting wherever stools can be used to advantage on the job, but where stools cannot be used, we take the training period to harden the students in the ability to stand during the working period and turn out the work. We have found that the point of fatigue varies with the individual, consequently, no set rule can be laid down. However, the student is not allowed to stand in the early course of the training for long periods, but rather the length of time a student can stand is graduated until, before the end of the course, she is able to stand for the full working period without undue tiredness or bodily discomfort. Another thing that must be borne in mind is that the job must be suited to the individual—no matter how willing the worker is, a light person of medium stature cannot be placed to advantage on heavy machine work and it seems invariably the rule that small people want to tackle the jobs which are the largest. However, these desires must be controlled and the physical requirements of the job and the ability of the worker must be matched as nearly as possible if lasting success is to be secured.

JIG DRILLING AND REAMING

SUGGESTED SPECIAL INSTRUCTIONS

In introducing women into the factory, it is quite obvious that a certain amount of educational work must be done in connection with the foreman and other employees already in control of the work and to this end, it is wise to issue some instructions. The following is suggested:

Adapting women to industry: We are attempting to adapt women to industry and not industry to women. Our factory system is built up as the result of generations of experience in manufacturing and the general shop principles which have brought success are still applicable and are in no way changed as a result of the introduction of women into industry.

Certain concessions must be made to women because of their sex, but when these concessions have been made, women should be accorded the same treatment which prevails in the case of the men.

ADVANCED TRAINING SCHOOL

Rest rooms. The subject of rest rooms is of prime importance. The rest room is established for two purposes—as a place for a woman to change her clothes, and to provide a space for the woman who is suddenly overcome with illness to rest in retirement. Rest rooms are not intended as a general loafing space, nor are women to be permitted to go out at any periodic time to the rest room for the purpose of loafing. If a woman is out of work, she is to remain at her machine or in the department, being, of course, allowed to sit down if her work required her to stand; but she is not to be rung out on idle time and sent to the rest room. It should be thoroughly understood that the rest room is provided for the ill only, and if a woman does not recover within a reasonable length of time, the hospital is to be notified and the woman removed to her home. Lunching is not to be permitted in the rest rooms. It should be thoroughly understood by all concerned that the rest room is a place for the sick.

Women who are taken into the factory are trained in our school. This training gives them the necessary physical ability to stand on their feet at work before they are turned out of the school as operators, consequently, there should be no reason for women going to the rest room if they are in good health and capable of being in the factory.

Our Advanced Training School

Having provided a source of labor through training to replace the supply wasted through natural causes, we must next turn our attention to the workers already in the factory. The help which in the past has been doing the so-called menial jobs, if endowed with ordinary intelligence, can more readily be educated than those who have no knowledge of the particular factory in which they are to work, and a body of trained workers can be recruited with good advantage from the untrained. In this way, it is possible to develop a force for night work where more than one shift is involved, as it is not considered good policy to employ women on night work in a shop operating mixed labor. The same training method can be applied and is being applied as in the case of women. To handle this phase of the question, we fitted up the basement of our training building to take care of men, and also to handle some women as our requirements out-grew our original school.

PACKARD REST ROOM FOR WOMEN IN TRAINING

After providing for the training of operators, we went one step further, that is, we provided a means of permitting the expert operator to become a job setter, sub-foreman, or foreman. Under the guidance of an expert mechanical engineer, we organized what is known as the "Advance Training School," shown in one of the accompanying views. In this school is taught the principles of foremanship, care of machinery, art of handling men, principles of premium system, job setter's relation to inspection and scrap, study of Packard routine and principles of safety first.

TRAINING SCHOOL FOR INSTRUCTORS

In closing, I desire to point out that the training is bound to become a feature in future factory organizations. It has been proven beyond a shade of doubt that a more successful body of workers can be obtained through preliminary training than without its aid. This training can be given at less cost, to better advantage and with less interference with production at a point removed from productive activities. The training school is with us and it is going to stay, consequently, it should be recognized as a feature of industrial life.

Industrial Army Necessary

Upon the Provost Marshal General's announcement of the regulations under the amended Selective Service Act, covering the appointment of three industrial advisers to the District Draft Boards, the Federal Directors of the United States Employment Service for the States were instructed from Washington to call at once a meeting of their State Advisory Boards for the purpose of recommending the Department of Labor's nominees as industrial advisers for each of the District Draft Boards in their States.

Graphic Production Control—III

How to Organize for Graphic Control

By C. E. Knoeppel

This installment of Mr. Knoeppel's *series is devoted entirely to the organization of an industrial control department. It shows what results such a department should give and then, in considerable detail, presents a series of typical graphs that have been used in controlling production. The way in which these are made, kept up to date and used is described in a most helpful manner.*

Mr. C. E. Knoeppel, *founder and president of the firm of* C. E. Knoeppel *& Co., Inc., consulting engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three firms of industrial engineers. This experience ultimately led to the founding of the organization of consulting, management and industrial engineers and experts of which he is now head and director.*

HAVING read the first paper on the underlying considerations of Graphic Production Control, and the second dealing with the fifteen laws of control, you as a reader may now ask, "Well, granted all you say about the subject, how am I to go about the matter of using graphics in production, and what method of graphics will I use; in other words, how will I organize for it?" This being a fair question, it is only proper that the writer should attempt, insofar as it is possible within the scope of a single paper, to work up an argument which would answer this question, prefacing the practical treatment with a few fundamentals which must not be ignored.

The three factors influencing the processing of materials are:

Plant arrangement, shop transportation, control of production.

If we analyze these three a moment, it will be found that the best plant arrangement with the most efficient shop transportation methods will not insure results if the methods of production control are at fault. On the other hand, given the most efficient methods of production control, with only a fair degree of efficiency as to arrangement and transportation, and better results will be forthcoming than in the case just mentioned. In other words, provide proper production control first, *then tone up and make better the arrangement of plant and the shop transportation of materials.*

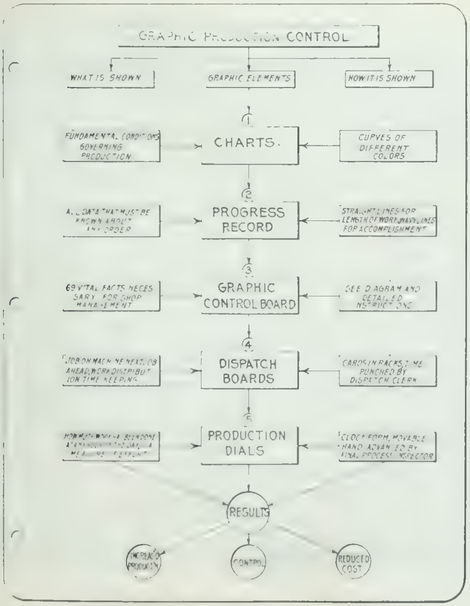

GRAPHIC PRODUCTION CONTROL
WHAT IS SHOWN
GRAPHIC ELEMENTS
HOW IT IS SHOWN
1
FUNDAMENTAL CONDITIONS GOVERNING PRODUCTION
CHARTS.
CURVES OF DIFFERENT COLORS
2
ALL DATA THAT MUST BE KNOWN ABOUT ANY ORDER
PROGRESS RECORD
STRAIGHT LINES FOR LENGTH OF WORK, WAVY LINES FOR ACCOMPLISHMENT
3
69 VITAL FACTS NECESSARY FOR SHOP MANAGEMENT
GRAPHIC CONTROL BOARD
SEE DIAGRAM AND DETAILED INSTRUCTIONS
4
JOB ON MACHINE NEXT JOB AHEAD, WORK DISTRIBUTION TIME KEEPING
DISPATCH BOARDS
CARDS IN RACKS, TIME PUNCHED BY DISPATCH CLERK
5
PRODUCTION DIALS
CLOCK FORM, MOVABLE HAND ADVANCED BY FINAL PROCESS INSPECTOR
RESULTS
INCREASED PRODUCTION
CONTROL
REDUCED COST

FIG. 6. GENERAL SCHEME OF GRAPHIC CONTROL

With this fundamental in mind, the next step is to create a mechanism to take over the work of intelligently and efficiently controlling production. This should be done through the organization of a CONTROL DEPARTMENT, a phrase which means more than "Production Department" or "Planning Department."

What will this CONTROL DEPARTMENT control? Let us determine what the elements are. The activities of the workmen must be guided or there will be only ordinary results in production. The movement of material as to purchase, receipt, issuance and transportation, must be intelligently guided. The work to be done or the operations must be known and properly defined. The equipment (machines, tools, jigs and fixtures) must be in readiness for the work that is to be done. Hence we have four elements in control under which can be classified, all factors influencing production, as follows:

Labor, which does the work
Material, on which the work is done,
Operations, which is the work done,
Equipment, with which the work is done.

If one or more of the four elements are neglected in, or eliminated from, any plan of production control, graphic or otherwise, do not look for any substantial results, *for they will not be forthcoming.*

Control brings labor, material, work and equipment together and coördinates them for efficient manufacture.

"But," you say, "why go to all the trouble of attempting to so thoroughly control production. Why not

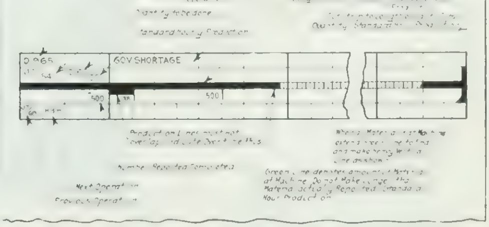


FIG. 7. STANDARD MARKING OF SCHEDULE STRIPS

leave it to the foremen?" My answer is, To do away with such conditions as the following actual cases:

A. When, in one plant hubs were moved a distance of 125 yards, one at a time by a gang of six men, with a machine using them at the rate of 7 to 8 per hour; when in the morning a foreman complained because he did not have enough material on his floor, while at the machines there was enough to last the afternoon, with more to follow the next morning; when a foreman wanted parts within a half hour, while the parts he desired were being assembled, others at the inspection benches and still others being tapped and drilled, these clearly indicated that the concern was jobbing and not manufacturing.

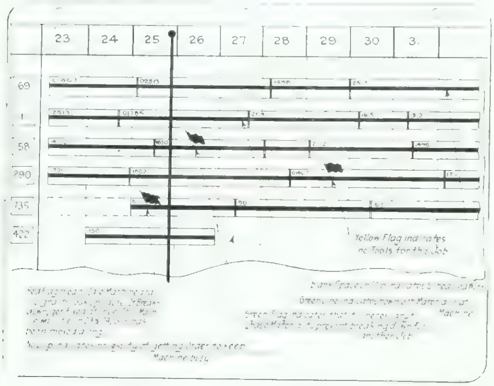


FIG. 8. SKETCH (NOT TO SCALE) SHOWING METHOD OF POSTING ON CONTROL BOARD

B. In one plant where planning methods were being introduced and where the shop management felt no planning was necessary, 88 per cent of the scheduling for one week was followed as planned. Of the planned jobs worked upon, 40 per cent were broken up for other work, showing that the shop had not planned carefully enough at the start. Each break averaged 1.68 changes. To show that it was not due to lack of work, it might be well to state that there were 4.1 weeks of work available and ahead of the shop.

C. In another plant on 110 jobs scheduled, 40 averaged 6.7 hours per operation, while 70 of them averaged 22.2 minutes per operation. Of these 70 jobs, 49 of them or 70 per cent. required six minutes per operation. On the basis of 22.2 minutes, it means 26 changes in a day. Is this manufacturing?

D. On order No. 8457 there were 757 hours of work to be performed. The shop had 12 days after it started work to meet the promise date. Work was finally completed in 27 days from the time the start was made. In the 12 days allowed the shop to finish on time, 9 hours of work were performed per day. In the remaining 15 days the shop averaged 43 hours work per day. As a result there were 78 hours of overtime charged to this order resulting in an excessive cost of $11.70. For the six days previous to the promise date the total time worked was 15 hours, or less than 3 hours per day. On one of the days after the promise date, 120 hours of work was done, or 12 men at 10 hours each.

E. In one case shipping data revealed: 8 orders shipped ahead of time, or 15 per cent; 1 order shipped on time, or 2 per cent; 44 orders shipped after promise date, or 83 per cent.

Have you ever asked yourself such questions as the following:

Why is it that the assembly foreman is continually complaining because he is out of a few parts to make the completed article?

Why is it that our production the last ten days of the month is five times as heavy as that of the early part of the month?

Why is it, despite the fact that our assembly department and sales department are crying for more parts, that we have so much idle equipment?

Why are we at times out of material when our inventory is 100 per cent greater than it used to be and our production has only increased 25 per cent.

If you have and have been unable to answer them to your entire satisfaction then you are safe in assuming that you need "graphic production control."

WHAT A CONTROL DEPARTMENT SHOULD DO

What you may expect from your CONTROL DEPARTMENT in the way of results, can be stated as follows:

1. Reduction of raw materials and work in process carried.
2. Prompt ordering of material required.
3. Notification to foremen of all operations necessary to make any piece, with the sequence in which they are to be made.
4. Prompt ascertainment by the foreman of the whereabouts of all material and supplies necessary to fill each production order.
5. Fuller utilization than formerly of the capacity of each machine.
6. Fuller utilization than formerly of the capacity of each workman.
7. Prompt following of each operation in any one department by the one ordered to follow it.
8. Prompt following of the work in any one department by that in the department next scheduled to follow it.
9. Insight into the state of progress of each job in process.
10. Information as to the lack of capacity of any one machine.

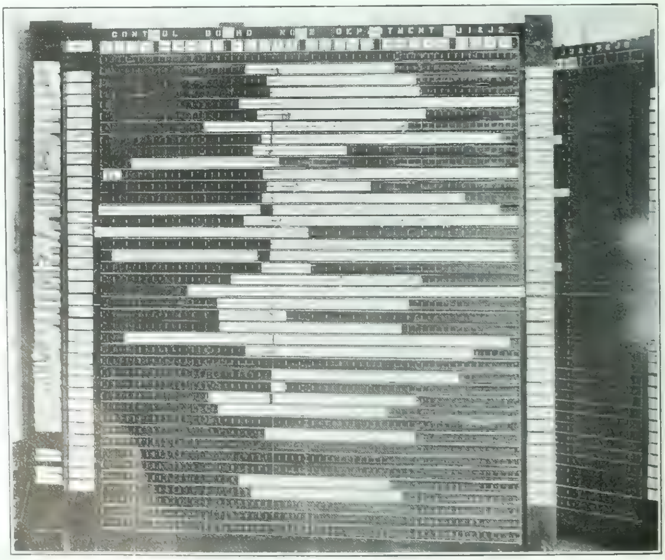


FIG. 9. CONTROL BOARD SHOWING PROGRESS OF OPERATIONS

11. Information as to the lack of capacity in any one department.
12. Reduction of overhead.
13. Reduction of material cost.
14. Reduction of direct labor cost.
15. Reduction of indirect labor cost.
16. Better relations between department heads.
17. Better relations between department heads and workmen.
18. More rapid production.
19. Avoidance of congestion in any one department.

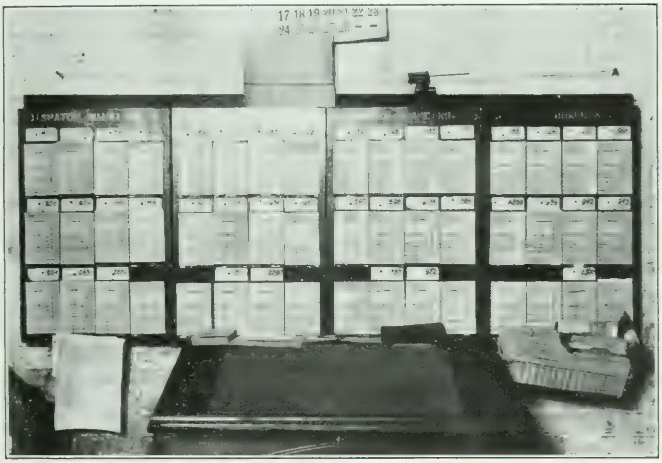


FIG. 10 VIEW OF A DISPATCH BOARD

20. Avoidance of congestion of any one machine.

Typical Graphs for Production Control

Let us now take up the matter of graphical presentation as it relates to controlling production, following it with an outline of typical graphs. The principle is simple:

> Vertical or horizontal lines through squares on cross section paper, cards or boards, which, with colored lines and colored flags or pins show all the necessary facts to indicate what is happening (performance), what is going to happen (planning), and what is likely to happen (lack of planning).

See Figures 12 to 20 inclusive for typical Graphic Production Charts.

There are many elements to be considered in graphic presentation. In other words, there are numerous ways in which facts can be presented graphically. Careful analysis reveals five essential elements around which this entire series of papers will be built:

1. *Charts* which control the conditions governing manufacture and which are used for reference purpose in keeping track of essential information.

2. *Progress records* which combined with order requirements, furnish all information with reference to orders.

3. *Graphic control boards* which furnish a true picture of the department or plant in miniature and which, with very little effort, can be made to reflect the vital points regarding shop control.

4. *Dispatch boards* which furnish the point of contact between the control boards and the shop operations.

5. *Production dials* which indicate graphically the production of a department or shop or specific product, in such a way as to indicate to the workmen their degree of performance on a particular task.

Figure 6 analyzes to a greater extent than the above these five elements.

In organizing for "graphic production control" the Control Department would:

1. Be responsible for the planning, routing and scheduling of all production details.

2. Coördinate the work of the engineering, purchasing, cost, tool and manufacturing departments.

3. Work in conjunction with the various department heads.

4. Act as a clearing house for all production data needed to guide properly the manufacture of a product.

With reference to the personnel of the Control Department, the head of this division should be a man of constructive ability, with previous experience in the particular field if possible. He should be a high grade man in every way. He should be given sufficient time to familiarize himself with the details of the factory processes and the cost methods in use before attempting to start active work. He should be free from routine duties, with the exception of approving the daily production schedules and the preparations of the necessary reports and analyses of conditions.

The second in command should be an understudy whose duties would consist in handling the details in connection with properly running an efficient Control Department. There would also be two or possibly three additional men whose duty it would be to work up the daily schedules and handle such other clerical work in connection with properly controlling production as it might be necessary, using girls for purely clerical routine.

This organization should be built up gradually and to familiarize the personnel with the work they should be employed at first in collecting data on machine capacities, operation names and numbers, shrinkage and rejection data, idle time reports, cost and time data and other essential information, compiling it all in proper form for quick reference. In other words, the organization of a Control Department would consist of:

1. *Control supervisor* who is really a production man having full charge of the department, being responsible for its proper operation and efficiency.

2. *Control clerk* who distributes the time cards to the various boards, notes accomplishments and is responsible for the accuracy of the boards.

3. *Order clerk,* whose duty comprises posting prog-

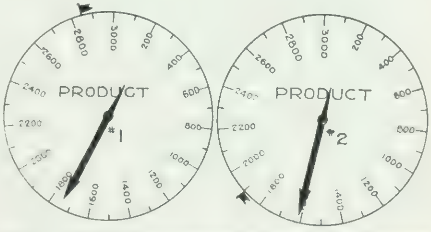


FIG. 11 GRAPHIC PRESENTATION OF SHOP OR DEPARTMENT PERFORMANCE

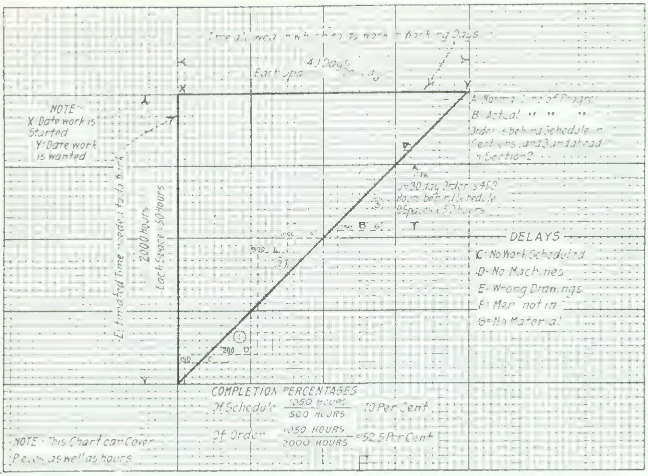


FIG. 12. ANGLE GRAPH SHOWING HOW PROGRESS IS WATCHED

ress and keeping track of all orders coming in and going out.

4 *Planning clerks* who make out all routing, time and progress cards and the schedule data for each order.

5. *Chief dispatcher* who is in direct charge of the dispatch clerks stationed at the various dispatch boards, and whose duties consist of chasing slow moving material, following up tool shortages, analyzing costs of machine idleness and following up machine repairs.

6. *Dispatch clerks* who are stationed at each dispatch board in the shops and who distribute the work as directed by the planning supervisor. They really act as time keepers, report receipt and delivery of material and must instantly notify the control department when the machines become idle.

The graphical scales used in "graphic production control" are generally of one coördinate—unit length—and represent several things, as follows:

1. Production by operations stated in quantities per unit of time.
    - (a) Quantities may be in units, weights, lengths, volume, standard cost or selling values.
    - (b) Units of time generally taken as an hour, or tenths of hours, or days.

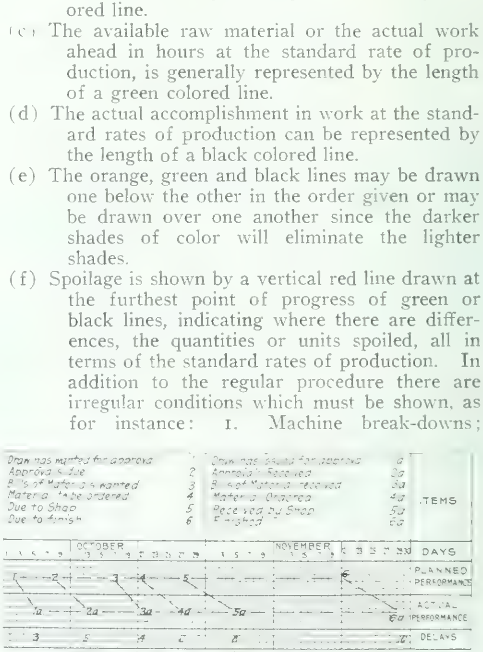
2. Amounts of raw and finished product, stated in quantities of parts, sub-assemblies or assemblies and supplemented by time datings, indicating the quantity of product scheduled, delivered or used.
    - (a) Quantities of parts and sub-assemblies are generally stated in terms of the assembled product—that is, if four parts are required in the finished machine the quantity is spoken of as so many finished machines.
    - (b) Assemblies decrease the quantities of parts or sub-assemblies and use is made of an arrangement of vertical lines, crossing off the graphic representation of the number of parts or sub-assemblies. See Figure 8.

The graphical scales in connection with control boards and charts are used in many ways, the conditions and peculiarities of the business in question determining the nature of the arrangement to use. Scales may be used in the following manner:

- (a) A strip of cardboard with suitable graphical scales superimposed on it and held in position by metal slides. See Figure 7.
- (b) Sheets of paper with a number of similar graphical scales printed on it, to be used in loose-leaf binders.
- (c) Time cards with suitable graphical scales printed on the edge, of which only a part is used, the part in use being displayed by overlapping of cards and held in position on the control board by suitable slides.
- (d) Vertical or horizontal pockets where space taken up by each pocket indicates a unit of time.

Accomplishments either scheduled or actual must always be registered as so much done in hours of work at standard rates of production. Several methods are used and are as follows:

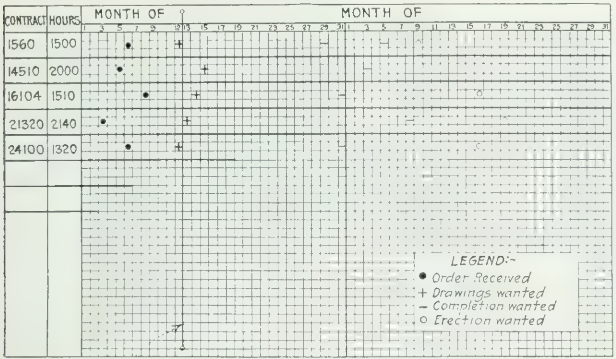
- (a) Colored lines drawn on the graphical scale, the length of the line representing the schedule time, available raw material ahead and accomplishments on the operations all in terms of standard rates of production. See Figures 7 and 8.
- (b) The schedule time may be represented by the length of a strip of paper on which the graphical scale is embodied. See Figure 7. At other times, when using a loose-leaf binder it can be represented by the length of an orange colored line.
- (c) The available raw material or the actual work ahead in hours at the standard rate of production, is generally represented by the length of a green colored line.
- (d) The actual accomplishment in work at the standard rates of production can be represented by the length of a black colored line.
- (e) The orange, green and black lines may be drawn one below the other in the order given or may be drawn over one another since the darker shades of color will eliminate the lighter shades.
- (f) Spoilage is shown by a vertical red line drawn at the furthest point of progress of green or black lines, indicating where there are differences, the quantities or units spoiled, all in terms of the standard rates of production. In addition to the regular procedure there are irregular conditions which must be shown, as for instance: 1. Machine break-downs;



NOTE:- Slant of Lines indicates Gains or Losses

CHART 13. SHOWING METHOD OF GRAPHICALLY FOLLOWING UP IMPORTANT FEATURES

NOTE. This method is especially useful in plants where orders, from receipt to completion, pass through a larger number of departments.



Plumb Line moved along each Day shows what is due the next Day and the Day following

CHART 14. CONTROL SHOWING IMPORTANT THINGS TO FOLLOW UP

2. lack of operators; 3. lack of material; 4. lack of small tools, jigs and fixtures; 5. lack of prints, samples, dies or gages; 6. improper working conditions; 7. lack of work.

There can also be many sub-divisions of the above reasons which operate against production and which in many cases would be taken into consideration. To call these irregularities to the attention of shop men certain signals can be used more or less alike in nature. They can all be applied on the principle that the signals indicate, by the position or location, the time of the occurrence of the condition and when the condition is relieved the signal is taken away. These signals may be listed as follows:

(a) Push pins with colored and numbered heads which are pressed in proper position in the wooden backing of the graphical scales.

(b) Colored tags or flags generally circular in form and which are provided with suitable clamps for attaching to the graphical mechanism.

(c) Colored stampings made on the graphical strips and which are crossed out as the conditions are relieved.

(d) Colored cards or inserts which are similar and applied in a manner like the form or card on which the graphical scale is printed.

Control boards are really maps showing all the production units of the shop and by production unit we mean machines, benches or working places. Each production unit stands by itself and the inter-relationship between the operations on all production units are established on a time basis because the graphical scale of time is the same for all production units.

In fact, you are able to know many other things in regard to each production unit. Part of this information is automatically stated in terms of the standard rates of production per unit of time and part by the relations brought out by the time scale. In addition, there are many pertinent details in connection with the work which is being done, which are written on the form or card carrying the graphical scale. See Figures 7 and 8. This information available on a control board is as follows:

(a) Hours of work scheduled ahead.

(b) Hours of work ahead for which material is available.

(c) Accomplishment in hours of work to date.

(d) Hours of work spoiled on previous operation.

(e) Hours of work spoiled at production unit in question.

(f) Times at which deliveries of material must be made from preceding operations or production rates.

(g) Times at which deliveries of materials must be made to next operation or production unit.

(h) Production unit or place at which previous operation is done or the source of routing.

(i) Production unit or place at which next operation is done or next place of routing.

(j) Shop order number, unit quantity on order, amount actually scheduled, descriptive name and number of part, the operation or operations done at the one setting and the standard productions per unit of time.

The areas on a control board given over to each production unit are generally squares or strips about one and one-half inch in width, arranged horizontally across the board. There is, under ordinary circumstances, room for about 50 strips of area per board or the graphical display for 50 production units. See Figure 9.

In determining the length of strips the number wanted is divided by the standard or estimated time per hour. For instance, 500 are wanted per hour and the work can be produced at the rate of 50 per hour. Then 500 is divided by 50, which is equal to 10 hours of work and the strip would be cut to this length and placed in the proper position on the board. See Figure 8.

The position occupied by each production unit on

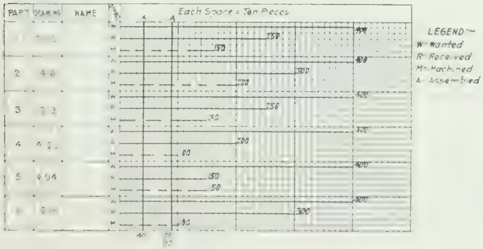


FIG. 15. CONTROL COVERING RECEIPT OF MATERIAL, MACHINING AND ASSEMBLY

This chart is a guide to machine and assembly foremen and to purchasing agent.

Note. Chart shows that more of part 5 should be secured from the outside. Also that before further assembly can be carried on, more of parts 1 and 4 must be machined.

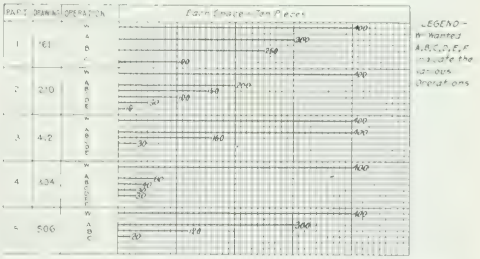


CHART 16. CONTROL COVERING PROGRESS OF CONSECUTIVE OPERATIONS IN PIECES

Note. How easy it is to follow the progress of the operations and to determine where to apply pressure.

Operations D & F part 3, E & F part 4 and D & F part 5 have not been started.

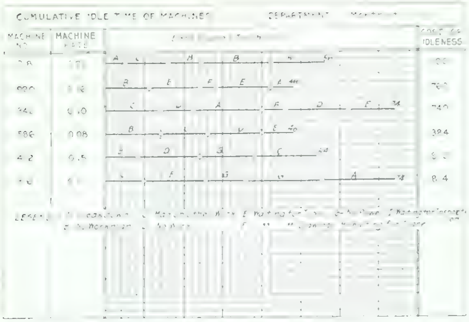


CHART 17. IDLE MACHINE REPORT

control boards is titled at the right and left hand with a card arranged in a suitable holder. The matter on the card is as follows:

(a) Machine, bench or floor number of the production unit as well as its departmental location.

(b) Descriptive name of the production unit.

(c) Range of the production unit.

(d) Specialty of the production unit.

To convey instructions to the shop to go ahead on work scheduled on control boards, a worker's job or time ticket is used, which is to show daily accomplishments and elapsed times and returned to the control boards. It is used as the basis of registering progress on work in process. The above procedure is called dispatching and will later be explained in more detail.

A ticket is to be used for each operation or series of operations at one setting, on each job performed by each production unit during any one day. There are many advantages in scheduling and getting the accomplishment and elapsed times on individual tickets and this should be adopted as one of the fundamental rules of good production control. It would be impossible to sort reports by shop order numbers or operations unless this was done. Figure 10 illustrates a form of dispatch board.

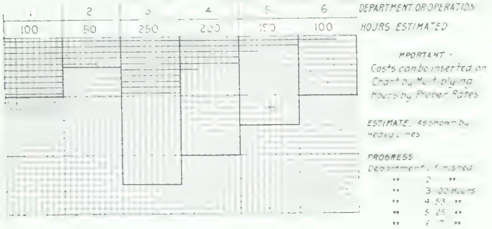


CHART 18. CONTROL SHOWING ESTIMATED TIMES, ACTUAL TIMES, AND PROGRESS

The handling of a great number of unclassified tickets with facility pre-supposes some means of definite distribution. This is admirably taken care of on control boards by arranging distribution racks on each side of the space provided for the graphical scales. Ordinarily these racks or series of card pockets are provided with two pockets on the left-hand end of the space apportioned to each production unit and one on the right-hand end. These pockets are used for the following purposes:

(a) Each upper left-hand pocket contains general data giving specific information about the capacities and specialties of that particular production unit.

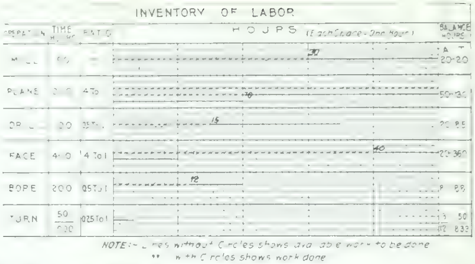


CHART 10. CONTROL OF HOURS OF LABOR AS TO WORK AVAILABLE, CONTINUOUS INVENTORY, BALANCES AND CORRECT SCHEDULING OF OPERATIONS

NOTE—This shows that out of the 1,000 hours to go as shown in second column, there are only 121 hours available (Col. A. Balance) with a balance of 833. (Col. T. Balance.)

PRINCIPLE

Only available work is posted against the various operations.

RATIOS

Ratios are found by dividing the time of each operation by the time of the preceding one.

LAW

No operation should be scheduled when its relation to the preceding operation is less than 1 to 1. The 70 hours finished at 2 only releases 35 to 3. work finished at 4-5 only releases 20 hours x 3 hours.

CHARGE CREDIT TO LABOR

Operation 1 is charged with 50 hs and credited with 30 hours finished

Operation 2 is charged with 120 hours (30 hours of Operation 1 x Ratio 4) and credited with 70 hours finished

Operation 3 is charged with 35 hours (70 hours x .5) and credited with 15 hours finished

Operation 4 is charged with 60 hours (15 x 4) and credited with 40 hours finished

Operation 5 is charged with 20 hours (40 x .5) and credited with 12 hours finished

Operation 6 is charged with 3 hours (12 x .25) with no credit.

(b) Each lower left-hand pocket holds the worker's current job and time reports of the last portion of the current month to date. This gives a continuous record of the schedule and accomplishments for each production unit. Periodically the older tickets are taken from distribution racks and filed away.

(c) Each right-hand pocket carries the job and time reports of jobs ahead, arranged in sequence in which they are scheduled against the given production unit. In such cases where the job and time report has a graphical scale incorporated upon it, and is itself the device used in posting the schedule in a graphical manner upon the board, the right hand carries the job and time reports on jobs ahead in excess of that posted on the boards.

The graphical scales for posting work against production units are usually arranged so that 250 hours of work may be posted against each machine, bench, floor or other working place. This is approximately equivalent to one month's work ahead at all times. The 250 hours is divided by vertical lines into 50-hour units and subdivided by other vertical lines of smaller section into 10-hour units.

Above the graphical scales, a date scale is arranged so that each day takes up a space equal to the number of shop working hours for the given day. As the days progress, a red vertical cord of large section is moved along each day. A comparison of the progress of work at each production unit with the position of the red vertical cord indicates whether the work is ahead or behind schedule.

We have incorporated in the foregoing description the essential features of a graphic production control board of the best type. There are many details which may vary more or less, as determined by the special conditions of each specific installation. The principles, however, are identical. We have more or less summarized some of these principal variations.

We desire to call attention to the fact that the type of control board, as described above, deals with the pro-

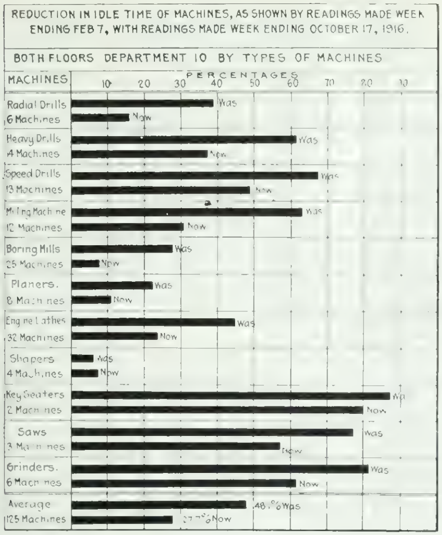
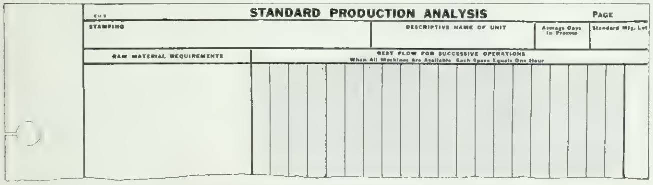


FIG. 20. DEPARTMENT 10—IDLE TIME REPORT, SHOWING COMPARISONS

duction operations on specific units or specific assemblies of units. Its principal ideal is to coördinate the successive operations on all available machines, benches and other working places, so that they will operate at a standard scheduled rate of production and that the time of the final finishing operations shall be predetermined.

In operating the control boards and the scheduling of machines on many jobs of work of different degrees of importance, which may vary from time to time, it is necessary that production standards be available for reference purposes. With standards for convenient reference, you are not obliged to go through the same analysis over and over again. You have something which is standard, until a better method is developed. You are able to schedule more directly and with greater speed.



STANDARD PRODUCTION ANALYSIS PAGE

STAMPING

DESCRIPTIVE NAME OF UNIT

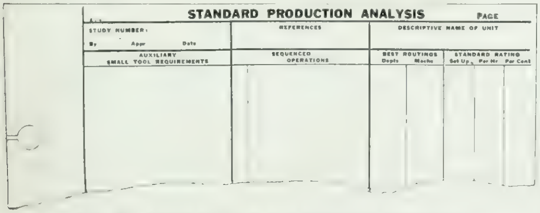
Average Days in Process

Standard Mfg. Lot

RAW MATERIAL REQUIREMENTS

BEST FLOW FOR SUCCESSIVE OPERATIONS When All Machines Are Available Each Space Equals One Hour

FIG. 21. A PORTION OF THE PRODUCTION ANALYSIS SHEET



STANDARD PRODUCTION ANALYSIS PAGE

STUDY NUMBER:

By Appr Date

REFERENCES

DESCRIPTIVE NAME OF UNIT

AUXILIARY SMALL TOOL REQUIREMENTS

SEQUENCED OPERATIONS

BEST ROUTINGS Depts Machs

STANDARD RATING Set Up Per Hr Per Cent

FIG. 22. ANOTHER FORM FOR RECORDING PRODUCTION

Standard production analysis sharts, see Figures 21 and 22, are also arranged graphically, that is, the interrelationship of successive operations. They also list much other standard data which is essential to real production control. On the usual standard production data chart we find the following information:

1. Descriptive name of the unit or assembly, with references to closely related drawings and other matter.

2. The part number, stamping or other names of identification of the unit or assembly.

3. The standard manufacturing quantity, on which the operation time analysis has been made.

4. The average number of working days in process under usual manufacturing conditions, which take into consideration the fact that machines are also occupied in doing other work.

5. The raw material requirements for the production of the standard manufacturing lot which is listed.

6. The sequenced operations as they are to take place under standard conditions.

7. The departments and machines and other working places which do the successive operations, that is, the routing.

8. The auxiliary small tool requirements for each operation.

9. The set-up times, productions per hour and percentage toward completion factors represented by successive operations.

10. The best flow for successive operations, when all machines are available. This last is displayed graphically and is really the most important feature for a capable manipulation of a shop so that idle equipment time will be a minimum and greatest production will result.

11. The study number, made by whom, approved by whom, and the date placed into action as a standard.

In the standardization of the best flow of operations from machine to machine, there are many matters which must be taken into consideration. It is evident that it would never be possible to schedule things in accordance with the ideal arrangement. At the same time, you desire to know how close together and interrelated you can schedule successive operations should the conditions permit. The following matters must be considered:

1. You cannot schedule a shorter operation to start at the same time a preceding longer operation starts, but you can schedule a longer operation to start at the same time a preceding shorter operation does.

2. You can split up short operations which follow long operations by periodicaly doing the short operations, as reservoirs of available material are accumulated from the preceding long operation. You gain considerable time in this manner providing the short operation is in turn followed by other long operations.

3. You can balance the flow of product by at times utilizing more than one machine on longer perations.

4. You must provide time for the transportation of material or usual delays between operations, as well as the size of the unit lots which it is economical to transport between operations.

Production dials are used to acquaint the shop workers and officials with the actual hourly performance against the standard hourly performance. See Figure 11.

To show the proper information on Control Boards t is necessary to follow ten important rules:

1. Represent each job by a schedule strip cut to length equal to the amount of order divided by stand-

ard hourly production as described heretofore.

2. Indicate by green crayon line on strip the actual material received at machine as given in report from dispatch clerk.

3. Indicate accomplishment by black crayon marked over the green, crediting machine at same rate as originally charged. Take report of accomplishment from time card.

4. Have a date line and move it forward every day.

5. Keep all black to left of date line, all green to right at all times.

6. Move schedule strips forward on back to accomplish this.

7. Use flags to signal principal delays.

8. Put machines on board in order of operation sequence.

9. Strips and board must be kept posted up to the minute.

10. Board must be constantly adjusted so that it always presents a true reflection of conditions in the shop. Dispatch clerks must distribute work to machines as directed from control board.

To give the reader a proper conception of requirements to keep in mind in organizing the Control Department the following is offered:

1. A knowledge of what to make, the quantities, and the time in which to make them.

2. Complete up-to-the-minute knowledge of stock receipts and disbursements.

3. Prompt checking of requirements against stock records.

4. Maintenance of stock margins that will insure material being on hand when wanted.

5. Analysis of the parts entering into the manufacture of the product, their operations and the estimated time per operation.

6. Routing of orders analyzed to machines and gangs.

7. Study of planning to avoid congestion.

8. Rearrangement of schedule to meet unforeseen contingencies.

9. Replacing spoiled or defective material.

10. Charting progress of orders.

11. Study of conditions interfering with prompt execution of plans.

12. Delivery of material to machine and gangs.

With these fundamentals in mind certain rules must be lived up to, as follows:

1. No work should be undertaken in any department of the plant without an order in writing.

2. No orders are to be started until they have first passed through the Control Department for attention and scheduling.

3. No job will be considered available until everything *is* or *will be* ready for the work.

4. No job is to be changed after starting until the Control Department has been notified and arranged for the changes.

5. No part of an operation is to be started by a succeeding operation until the Control Department has arranged for it.

6. Sufficient work must at all times be scheduled ahead so that there will be no likelihood of a machine or gang running out of work. Better to schedule too much work than not enough.

7. No material is to be moved to a starting operation without the knowledge of the Control Department.

8. Jobs must be arranged and given out in the order scheduled.

9. The routing indicated for a job is not to be changed except on authority of Control Department.

10. Time cards must register actual times and amounts produced.

11. Each operation must be reported on a separate card showing time and count.

12. Idle time must be shown on a separate card.

In starting the work of controlling production graphically, it might be well to outline the nature of the program to inaugurate. This program can be expressed along the following lines:

1. Classify and symbolize the product as well as blueprints and other records concerning it.

2. Standardize and symbolize production operations.

3. Number the machines, working places and workmen and list according to departments.

4. Classify and list the specialty of each machine and workman.

5. Classify and commence to follow progress on production orders.

6. Install dispatch boards and get every machine and man on a "job ahead" basis.

7. Install dispatch racks for incoming and outgoing materials as well as material in process.

8. Standardize operations in sequence of machines where work is best done and begin to determine set-up times and production per hour in each unit of product.

9. Work up standard relationship charts showing the flow of product from operation to operation, by details and assemblies in its progress toward the completed article.

10. Begin to follow progress on unit quantity production, its sales or cost valuation and the relationship of sales or cost valuation to the combined direct or indirect payroll, charting this information for the benefit of the plant executives.

11. Write up functions and duties of Control Department personnel.

12. Install control boards and start scheduling machines, revising schedules as production rates per hour change.

13. Commence a standardization as to quantity and kind of all small tools.

14. Begin the task of standardizing the feeds, speeds and cuts of the machines.

15. Standardize the various operations as the basis for task setting and provide the workmen with incentives.

This installment has given the essential elements necessary to consider in organizing a Control Department, and following sections will more thoroughly explain the rules, elements and requirements of such a department.

(To be continued)

* * * *

Justice

"Belgium must be restored. Alsace-Lorraine must be returned to France,—unconditionally returned,—not merely because sentiment and eternal justice demand it, but because the iron and coal of Lorraine must be forever taken from Germany. *Italia irredenta*—all those areas where the Italian race is predominant, including Trieste, in Austria, must go back to Italy; Serbia and Roumania must be established in their independence and Greece must be secure. Most important of all, if we are to make the world safe in the way we mean it to be safe, the great Slav populations now under the government of Austria—the Jugo-Slavs and the Czecho-Slovaks, who have been used to aid the Germans, whom they loathe—must be established as independent states. The Polish people must have an independent Poland." —*Senator Henry Cabot Lodge.*

Cost Accounting to Aid Production—II

Standards and Standard Costs

By G. Charter Harrison

The fundamental purpose of scientific management is to substitute definite standards for rules-of-thumb. So the author asserts that the introduction of a system of standard costs should precede the installation of other methods such as planning and dispatching. Standard costs can not only be used as a basis to figure costs under current conditions, but also to pre-estimate or predict costs. The cost accountant of the future must exercise imagination and possess the ability to make intelligent forecasts.

Mr. G. Charter Harrison *was born and educated in England and passed eighth in order of merit in the final examination of the Institute of Chartered Accountants in England and Wales. For eight years, up to October, 1916, he was employed by Price, Waterhouse & Company in various capacities; during the latter part of this period as manager of the system division of that firm. From January, 1909, to February, 1911, he was comptroller for the Russell, Burdsall & Ward Bolt & Nut Company. In November, 1916, he entered into partnership with the principals of Baker, Sutton & Company, London, England, chartered accountants, under the firm name of Baker, Sutton & Harrison. Owing to conditions brought on by the war that firm dissolved in May, 1918. Mr. Harrison took over the business and has continued it under his own name.*

THE use of standards by the human race dates back to the early dawn of civilization. The sparks made by a stone-age savage in chipping a flint arrowhead falling upon some dry grass and setting fire to it resulted in the adoption of a standard method of producing fire, which was very little changed until the lucifer match was substituted for the flint and tinder of our forefathers' time. The savage who, tiring of the effort involved in killing fish by means of a spear and who using guile in place of force, took advantage of the greediness of his prey and made a primitive hook by lashing a piece of curved shell with fibre to a piece of bone or wood, introduced a standard method of catching fish, the principle of which is identical to that followed by the modern angler.

The forward march of civilization has only been rendered possible by the adoption of standards. Standards passed on from father to son and from generation to generation represent the ratchets on the wheels of progress, and have enabled each forward step painfully and slowly made, to be maintained. Without the privilege of drawing on the accumulated experience of the race as represented by its standards, each individual would be compelled to start in right at the beginning and progress would have been impossible.

The application of the principle of standards to cost accounting institutes the pre-determination of costs, demands that no work shall be undertaken without its cost have been calculated in advance, and changes the whole viewpoint of cost accounting from retrospection to prospection.

Whereas the savage had very few and simple standards, as civilization developed standards increased in tremendous degree both as regards number and complexity, and in modern life the standards covering the multitudinous activities of human kind are of incalculable number.

In these articles we are interested only in standards so far as they concern industrial life and here at the outset we are confronted with the fact that it is possible to have many standard ways of doing the same thing. Until recent years the standards followed by the various trades were largely rule-of-thumb or traditional knowledge and as Mr. Taylor stated in the "Principles of Scientific Management."

> "Instead of having only one way which is generally accepted as a standard, there are in daily use, say, fifty or a hundred different ways of doing each element of the work."

FALSE IDEALS AND STANDARDS

In the management end of industry we also find a variety of standards or ideals, many of which are wholly false or only partly true. In some concerns the main standard appears to be a large tonnage and where this idea is most rampant, time and time again it will be found that at the close of the month light but highly profitable work will be relentlessly side-tracked, no matter how urgently required by the customer, in order to manufacture some relatively unprofitable but heavy material for which there is no immediate demand but which will enable the month's tonnage production to appear in a favorable light to the directors. We are all familiar with the wild scramble in many shipping rooms at the close of the month to get out as many goods as possible in order to swell the month's shipments and it would be difficult to estimate the number of mistakes which are a result of this somewhat misguided enthusiasm, due to the setting up of a false or at least an inadequate ideal or standard.

Reference has previously been made to other false ideals or standards common to manufacturing institutions, such as to realize as high a percentage as possible of piece work, or of so-called productive labor, but while such standards are to some extent founded upon knowledge gained from practical experience they present a dangerous tendency to grasp at the shadow and lose the substance. This is particularly so as regards the introduction of piece-work rates on a large scale without proper consideration.

The fundamental idea underlying scientific management is the substitution of definite, scientifically determined standards for all these nebulous ideals, and clearly defined methods of reaching these standards for haphazard and rule-of-thumb methods. This obviously applies to all phases of scientific management such as time and motion study, standard practice instructions and planning and dispatching methods.

It is the province of the engineer to determine the standards for use in the shops and to provide for proper methods to be adopted for the realization of these standards.

In view of the complexity and number of standards employed, it is obvious that some means must be provided for showing the extent to which the results actually obtained conform to the standards set up, and this demands the maintenance of records. It is the province of the accountant to provide and carry along such records.

Relation of Standards and Records

Standards and records are as inseparable ideas as latitude and longitude, debit and credit, east and west. Standards without records are as ineffective as firing at a target would be if the marksman had no means of determining whether he was making hits or not, and, *vice-versa,* records without standards would be equivalent to carefully recording the result of every shot but giving the marksman no definite target at which to aim. With standards and no records we are in the position of a traveller with a time table and no watch, while conversely with records without standards we are in the position he would be with a watch but no time table.

A very common illustration of standards without records is presented by the concerns who issue many rules and instructions but provide no systematic method of ascertaining whether such instructions are followed, with the inevitable result that they are "more honor'd in the breach than the observance," and in the innumerable systems which are operated in a way far different from that originally intended. As Mr. Gantt states:

> Many shops have a very nice schedule system; they plan their work beautifully—at least, it looks very pretty on paper, but they have no means of finding out whether those schedules are lived up to or not. Usually they are not.

The majority of cost accounting systems are representative of records without standards with the result that a great proportion of the information compiled is meaningless and valueless, as the data obtained, not being shown in relation to any standard of attainment, is largely without significance.

A further illustration of the use of records without standards is that of the man who keeps the most minutely detailed account of his personal expenditures, but has no budget to work to, with the result that having no definite scheme of saving, his accounts do not materially aid him in this connection, but merely provide him with the sad history of where his money went.

Numerous illustrations of standards combined with records present themselves, among which may be mentioned: taximeters which show the actual amount earned figured at a standard rate for a certain distance; the time book on which a red line is ruled at the opening hour, all persons signing above the red line being on time and all after late; or the recording time clock which shows in printed red ink figures all cases of tardy arrivals, or variations from standard. The budget systems of finance when properly carried out are perfect examples of the effectiveness of combining standards and records, the standards being the appropriations made for the various purposes and the records showing the extent to which the actual payments made conform to these standards.

The average office affords an illuminating illustration of operations being performed with neither standards nor records. In many offices those in charge have but the vaguest idea of the volume of work which should be performed in a day and maintain no records showing the work done by individuals with the result that office help generally is notoriously inefficient. The average office employee adjusts his pace to meet the immediate demands upon him as represented by the work ahead. The writer calls to mind a case which came to his experience where, in a seasonal business, the sales in three months of the year aggregated as much as in the remaining nine months, yet in spite of the very small amount of work requiring to be performed by the bookkeepers during the slack months they appeared just as busy as during the heavy shipping season.

The application of the principles of standards to cost accounting necessitates the predetermination of costs—that nothing should be undertaken without its cost having been calculated in advance. It changes the whole viewpoint of cost accounting from retrospection to prospection.

Can Costs Be Predetermined?

The argument may be advanced that it is not possible to predetermine costs, particularly in jobbing shops and industries manufacturing a non-standardized product, but any doubts that the writer may have previously had in this connection were dispelled by the testimony of Mr. W. B. Ferguson, who in his valuable book "Estimating the Cost of Work" demonstrates the feasibility of predetermining costs in so difficult a class of work in this respect as that of ship repairing.

The strongest objection to this method of cost accounting will probably come from cost accountant lacking the practical experience necessary to estimate the cost of work, but as previously stated it is not the province of the accountant to set up standards, it is primarily that of an engineer or an experienced shop man working in conjunction with the accountant.

Even though there may be cases where sometimes it is difficult to obtain a very accurate estimate of the cost of doing any work it is contended that any estimate carefully made is far better than none at all. It at least gives some incentive to work to.

In cases where bids are made for contracts, there is no argument as to the necessity for predetermining costs, and this rule applies in any case where the price is made in advance. The cost-plus system is a makeshift, a relic of the days when costs were regarded solely in the retrospective sense. There is little that can be said in its favor and it obviously is fundamentally incorrect in principle as offering a premium for incompetency and waste.

Of course, to some extent predetermined costs are used in all manufacturing concerns of any magnitude, this applying particularly to plant improvement work where it is the usual practice to make an appropriation based upon the estimate of the man in charge of the work. Any plant manager can testify as to the difference in the manner in which construction work will be handled when there is a definite cost figured in advance and the engineer in charge held accountable for keeping to the figure of the appropriation, and where there is no standard fixed and no incentive to keep the cost to any definite figure.

This principle applied to all work performed will have the same effect as regards economical manufacturing. Instead of working haphazardly toward more or less nebulous ends, in a concern where standard costs are used, every member of the organization will be provided with definite incentives, responsibilities and records of accomplishment.

In the majority of standardized industries such as that of the manufacture of automobiles, the price of the article to be sold is often set long before it is manufactured in sufficient quantities to enable compiled detailed costs to be a guide to the cost under quantity production conditions. Often the price of an article is set immediately the experimental model has been approved.

Standard Costs the Fundamental Improvement

The writer joins issue with Mr. Benjamin A. Franklin that the installation of adequate methods of cost accounting is the basic and fundamental factory improvement. The introduction of a system of standard or predetermined costs should, in the writer's opinion, precede the introduction of scientific management in the shop, such as in the installation of methods of planning and dispatching. This particularly applies to those organizations where the will to be efficient is not fully developed, for the operation of a cost system along the lines mentioned will of itself to a large extent force upon such an organization the necessity for adopting the correct viewpoint and scientific management methods.

Once such a system of accounting is installed, the work of the efficiency engineer is greatly facilitated, and he can then introduce his changes gradually and with the full knowledge that the accounting system will at all times enable him to determine the extent to which his work is successful. The substitution of the scientifically calculated standards of the engineer for the more or less arbitrary standards previously in force will present no particular problem.

Just as electricity is a standard form of power the uses of which are universal and far-reaching, so are scientific standards of operation of manifold usefulness. In brief, standard costs serve the following:

1. The foundation for setting selling prices.
2. The incentive to manufacture for the price set.
3. A gage of efficiency in manufacturing.
4. A gage of selling efficiency.
5. A common unit of measurement so that all cost information can be brought to a focus.

By their scientific employment standard costs can be made to give results not possible in systems where they are not used. For instance, in a concern manufacturing a line of standard machines it is possible to adjust a standard cost to the basis of actual conditions with great facility.

The advantage of having some common unit of comparison for cost purposes will be evident to any manufacturer who has endeavored to bring to a focus the information presented to him by his cost department. This ideal is easily realized, of course, in the case of the manufacturer of a simple product, such as cement, where all cost data are naturally given in relation to the number of barrels of cement manufactured—labor so much a barrel, repairs so much, power so much and material so much. By the use of standard costs, however, the cost statement of a manufacturer of a line comprising several hundred machines, thousands of parts and tens of thousands of operations can be expressed as simply as those of the cement manufacturer, all costs being shown in relation to a common unit of measurement, namely, the dollar of standard cost.

Principles of a Cost System Based on Standards

The underlying principles of a system of cost accounting based upon the use of standards may best be understood by considering an exceedingly simple illustration. Accordingly, in Figure 3 is shown in diagram form the essential features of a system of cost accounting to meet the requirements of a hypothetical case, in which it is assumed that a manufacturing concern has accepted a contract for the manufacture of several million machine bolts at a price of $13 a thousand. It is further assumed for the sake of simplicity that the business in question is confined to the performance of this contract.

Before making a bid for this work the cost department has been instructed to make a careful estimate of the cost of making this bolt and in the "Standard Cost Card" shown in Form I it will be seen that the estimated or standard cost of the bolts is $11.079 per thousand and, therefore, the estimated or standard profit on the contract is $1.921 a thousand.

This diagram illustrates the following important information obtained by the use of standard costs:

Manufacturing efficiencies
Current costs
Cost of sales

Manufacturing Efficiencies

Now the executive of a concern engaged in the carrying out of a contract such as has been described is primarily interested in knowing the extent to which the actual costs vary from the standard and the causes underlying these variations. All of his plans are based upon the assumption that he is going to realize his standard of profit of $1.921 per thousand and, the selling price of the bolts being fixed, his activities will be solely directed to keeping the manufacturing cost to the standard or below it. The variations from standard are brought to a focus on the Summarized Manufacturing Efficiency Statement (Form A) which shows the actual and standard expense of material, labor and burden, and the increases or decreases comparing actual cost with standard, the former being shown in red and the latter in black.

Considering this statement in detail, obviously the first thing that will strike the eye of the executive is the red ink figure showing that the actual cost of the month's operations is $2,816.30 in excess of standard, this increase analyzed under the heads of material, labor and burden being as follows:

Material	$1,395.00
Labor	210.30
Burden	1,211.00
Total	$2,816.30

This increased cost which represents 8.7 per cent. of standard is obviously a serious matter for the standard profit, on which the executive has calculated, represents only a little over 17 per cent. of standard cost, so that it may be assumed that he will immediately institute a searching enquiry as to the reasons why his plans have so sadly fallen down, so that prompt steps can be taken to eliminate all preventable inefficiencies and reduce costs as nearly as possible to the standard adopted.

Following the same process as the executive would, we will consider each item of cost appearing on the Summarized Manufacturing Efficiency Statement individually and in the order in which they appear on the statement.

Material.—The increased cost of material totalling to $1,395 details of which are shown on the Summarized Material Report (Form C) is divisible as follows:

Due to price fluctuations	$1,125.00
Due to fluctuations in use efficiency	270.00
Total increase	$1,395.00

The increased cost due to price fluctuations is made up as follows:

	Pounds	Price	Amount
Actual cost of material used in month	1,125,000	$1.90	$21,375.00
Standard cost of material used in month	1,125,000	1.80	20,250.00
Increase of actual over standard		$ .10	$1,125.00

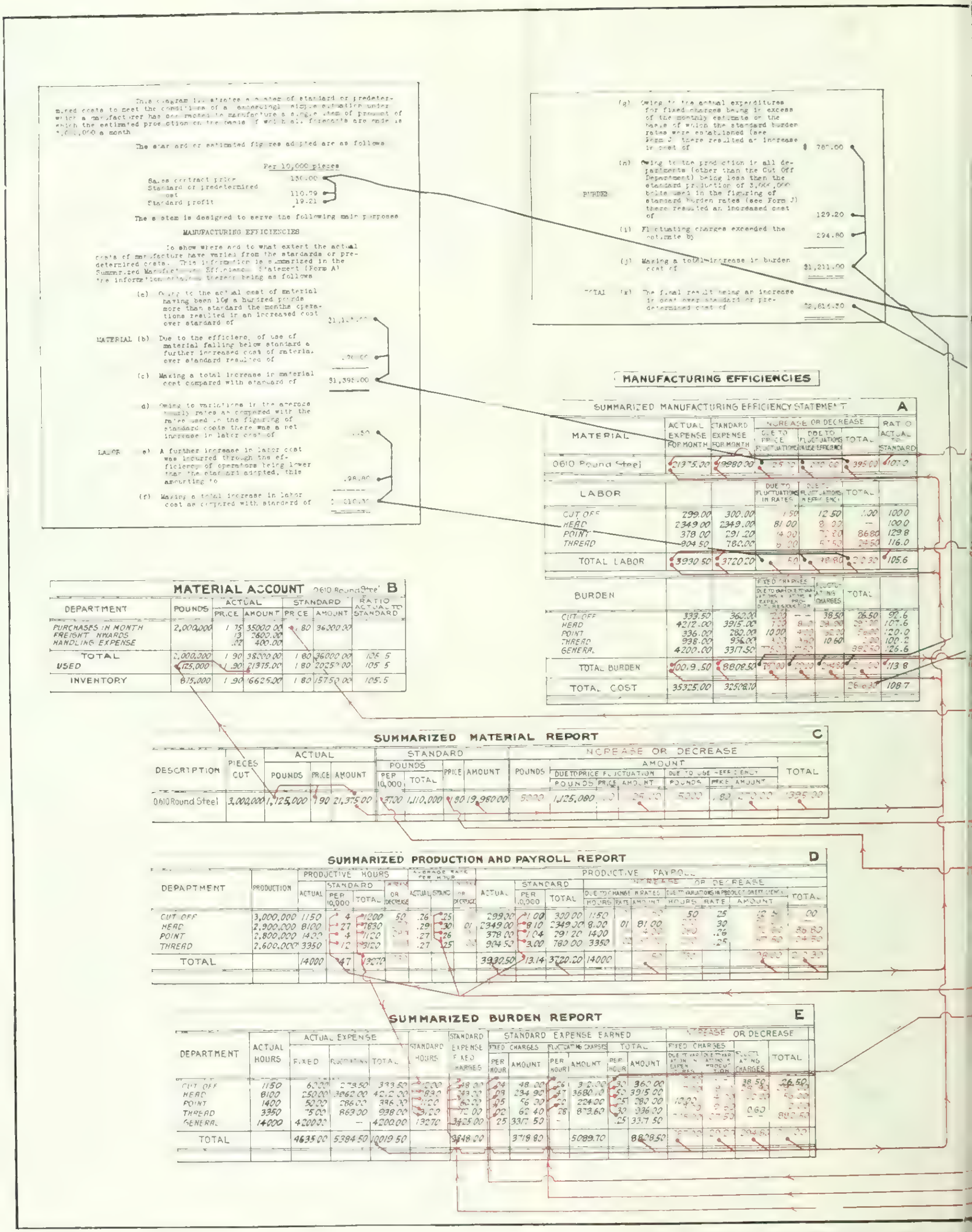

MANUFACTURING EFFICIENCIES
SUMMARIZED MANUFACTURING EFFICIENCY STATEMENT A
MATERIAL ACCOUNT B
SUMMARIZED MATERIAL REPORT C
SUMMARIZED PRODUCTION AND PAYROLL REPORT D
SUMMARIZED BURDEN REPORT E

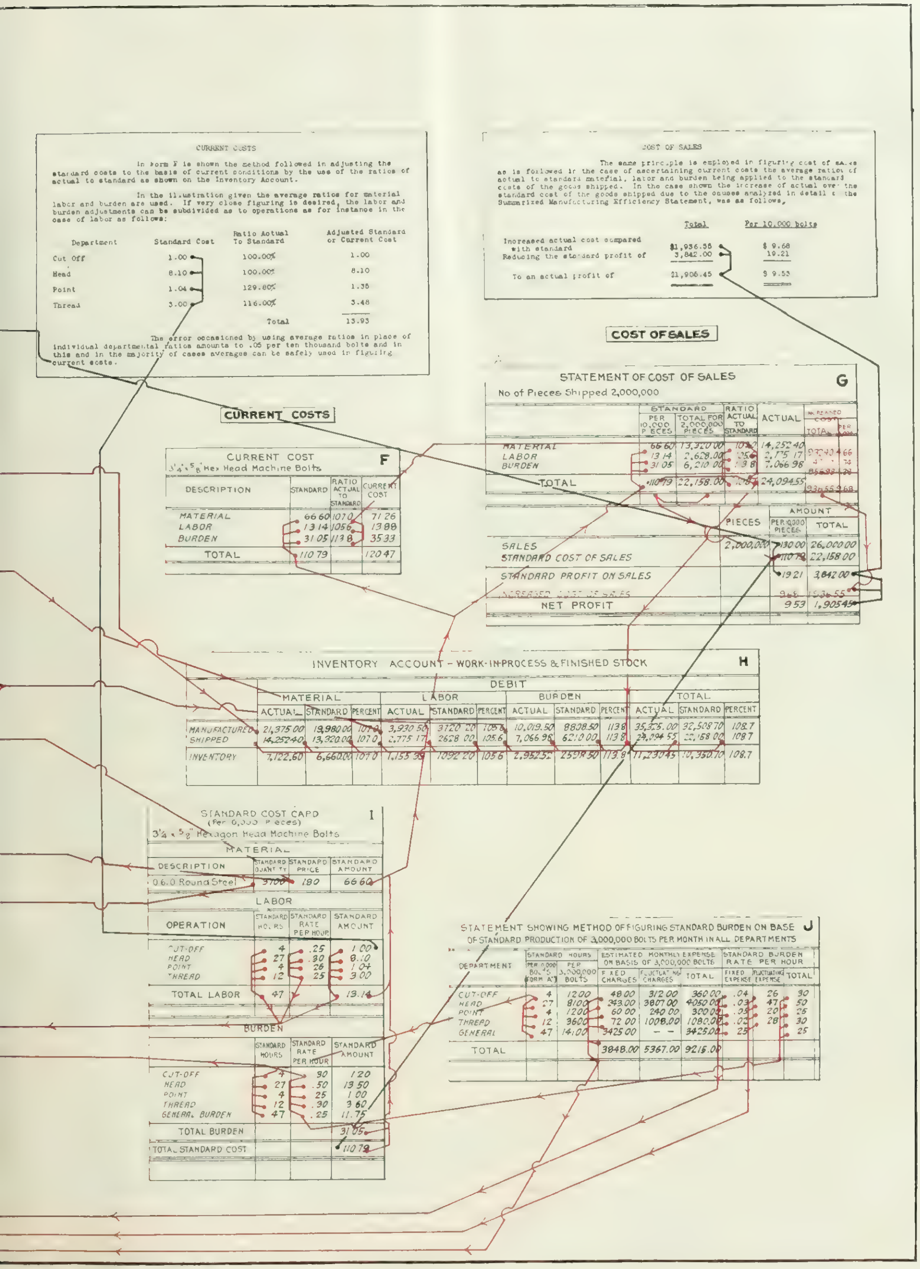
FIG. 3. DIAGRAM ILLUSTRATING PRINCIPLES

The increased cost of .610-inch round steel of $.10 per hundred pounds is apparently due to a serious error in figuring the standard cost of this material at $1.80, for the Material Account (Form B) indicates that the actual cost of the material received during the month, per hundred pounds, was as follows:

Purchase price	$1.75
Freight inward	.13
Handling expense	.02
	$1.90

The material presumably having been bought on contract, the freight being a fixed charge, the only possibility of reducing this loss resulting from price variations would be as regards the small expense of handling. Here obviously it would be desirable to adjust the standard cost and the plans based thereon.

The increased cost of material due to the quantities used being in excess of standard will then call for attention. This increase is made up as shown on the next page, as follows:



CURRENT COSTS

In Form F is shown the method followed in adjusting the standard costs to the basis of current conditions by the use of the ratios of actual to standard as shown on the Inventory Account.

In the illustration given the average ratios for material labor and burden are used. If very close figuring is desired, the labor and burden adjustments can be subdivided as to operations as for instance in the case of labor as follows:

Department	Standard Cost	Ratio Actual To Standard	Adjusted Standard or Current Cost
Cut Off	1.00	100.00%	1.00
Head	8.10	100.00%	8.10
Point	1.04	129.80%	1.35
Thread	3.00	116.00%	3.48
		Total	13.93

The error occasioned by using average ratios in place of individual departmental ratios amounts to .05 per ten thousand bolts and in this and in the majority of cases averages can be safely used in figuring current costs.

COST OF SALES

The same principle is employed in figuring cost of sales as is followed in the case of ascertaining current costs the average ratios of actual to standard material, labor and burden being applied to the standard costs of the goods shipped. In the case shown the increase of actual over the standard cost of the goods shipped due to the causes analyzed in detail on the Summarized Manufacturing Efficiency Statement, was as follows,

	Total	Per 10,000 bolts
Increased actual cost compared with standard	$1,936.55	$ 9.68
Reducing the standard profit of	3,842.00	19.21
To an actual profit of	$1,905.45	$ 9.53

CURRENT COST F

3¼" × ⅝" Hex Head Machine Bolts

DESCRIPTION	STANDARD	RATIO ACTUAL TO STANDARD	CURRENT COST
MATERIAL	66 60	107 0	71 26
LABOR	13 14	105 6	13 88
BURDEN	31 05	113 8	35 33
TOTAL	110 79		120 47

STATEMENT OF COST OF SALES G

No of Pieces Shipped 2,000,000

	STANDARD		RATIO ACTUAL TO STANDARD	ACTUAL	INCREASED COST	
	PER 10,000 PIECES	TOTAL FOR 2,000,000 PIECES			TOTAL	PER 10,000
MATERIAL	66 60	13,320 00	107 0	14,252 40	932 40	4 66
LABOR	13 14	2,628.00	105 6	2,775 17	[illegible]	74
BURDEN	31 05	6,210 00	113 8	7,066 98	856 98	28
TOTAL	110 79	22,158.00	108 7	24,094 55	1936 55	9 68

	PIECES	AMOUNT	
		PER 10,000 PIECES	TOTAL
SALES	2,000,000	130 00	26,000 00
STANDARD COST OF SALES		110 79	22,158 00
STANDARD PROFIT ON SALES		19 21	3,842 00
INCREASED COST OF SALES		9 68	1,936 55
NET PROFIT		9 53	1,905 45

INVENTORY ACCOUNT – WORK-IN-PROCESS & FINISHED STOCK H

	DEBIT											
	MATERIAL			LABOR			BURDEN			TOTAL		
	ACTUAL	STANDARD	PERCENT	ACTUAL	STANDARD	PERCENT	ACTUAL	STANDARD	PERCENT	ACTUAL	STANDARD	PERCENT
MANUFACTURED	21,375 00	19,980 00	107 0	3,930 50	3720 20	105 6	10,019.50	8808.50	113 8	35,325.00	32,508 70	108.7
SHIPPED	14,252 40	13,320.00	107 0	2,775 17	2628 00	105.6	7,066 98	6210 00	113 8	24,094 55	22,158 00	108 7
INVENTORY	7,122.60	6,660.00	107 0	1,155 33	1092 20	105 6	2,952 52	2598 50	113.8	11,230 45	10,350.70	108.7

STANDARD COST CARD I

(Per 10,000 Pieces)

3¼ × ⅝" Hexagon Head Machine Bolts

MATERIAL

DESCRIPTION	STANDARD QUANTITY	STANDARD PRICE	STANDARD AMOUNT
0 6.0 Round Steel	3700	1 80	66 60

LABOR

OPERATION	STANDARD HOURS	STANDARD RATE PER HOUR	STANDARD AMOUNT
CUT-OFF	4	.25	1 00
HEAD	27	.30	8.10
POINT	4	26	1 04
THREAD	12	25	3 00
TOTAL LABOR	47		13.14

BURDEN

	STANDARD HOURS	STANDARD RATE PER HOUR	STANDARD AMOUNT
CUT-OFF	4	30	1 20
HEAD	27	.50	13 50
POINT	4	25	1 00
THREAD	12	.30	3 60
GENERAL BURDEN	47	.25	11.75
TOTAL BURDEN			31 05
TOTAL STANDARD COST			110 79

STATEMENT SHOWING METHOD OF FIGURING STANDARD BURDEN ON BASE OF STANDARD PRODUCTION OF 3,000,000 BOLTS PER MONTH IN ALL DEPARTMENTS J

DEPARTMENT	STANDARD HOURS		ESTIMATED MONTHLY EXPENSE ON BASIS OF 3,000,000 BOLTS			STANDARD BURDEN RATE PER HOUR		
	PER 10,000 BOLTS (FORM A)	PER 3,000,000 BOLTS	FIXED CHARGES	FLUCTUATING CHARGES	TOTAL	FIXED EXPENSE	FLUCTUATING EXPENSE	TOTAL
CUT-OFF	4	1200	48 00	312 00	360 00	.04	26	30
HEAD	27	8100	243.00	3807 00	4050 00	.03	47	50
POINT	4	1200	60 00	240 00	300 00	.05	20	25
THREAD	12	3600	72 00	1008.00	1080.00	.02	28	30
GENERAL	47	14100	3425 00	— —	3425.00	25		25
TOTAL			3848.00	5367.00	9215.00			

SYSTEM OF STANDARD OR PREDETERMINED COSTS

	Pounds	Price	Amount
Actual material consumption figured at standard price...	1,125,000	$1.80	$20,250.00
Standard material consumption figured at standard price	1,110,000	1.80	19,980.00
Increased material consumption figured at standard price	15,000	$1.80	$270.00

The standard consumption shown above is obtained by extending the standard quantity of material as shown on the Standard Cost Card (Form I) by the number of bolts cut off as shown on the Summarized Material Report as follows:

Standard quantity of material per 10,000 bolts	3,700 pounds
Standard quantity of material per production of 3,000,000 pieces	3,700 × 300 = 1,110,000 pounds.

The details of the material used would be obtained from the detailed material requisitions which would show for each batch of parts cut the material actually used and the standard. From these, daily reports would be made for the executive showing the extent of the variations between actual and standard. These requisitions would be analyzed by machines so that inefficiencies could be traced to individual operators. By this means the manufacturing executive could maintain the closest supervision over the use of material.

Labor.—The total increased labor cost of $210.30 comparing actual with standard, as shown by the Summarized Manufacturing Statement, is made up as follows:

Operation	Actual expense	Standard expense	Increases or decreases due to fluctuations in rates		Increases or decreases due to fluctuations in efficiency	
			Increase	Decrease	Increase	Decrease
Cut off	$299.00	$300.00	$11.50			$12.50
Head	2,349.00	2,349.00		$81.00	$81.00	
Point	378.00	291.20	14.00		72.80	
Thread ...	904.50	780.00	67.00		57.50	
Totals	$3,930.50	$3,720.20	$92.50	$81.00	$211.30	$12.50
Net increases or decreases..			$11.50		$198.80	

In the Summarized Production and Payroll Report shown in Form D is illustrated the manner in which the variations in labor costs are determined. The standard productive hours and payroll figures are obtained by extending the standard hours and amounts as shown on the Standard Cost Card (Form I) by the production as appearing in the column so headed on the Summarized Production and Payroll Report (Form D). The increases and decreases in the cutting department are arrived at as follows:

	Hours	Rate per hour	Amount
Standard			
Per 1,000 pieces per standard cost card (Form I)	4	$0.25	$1.00
Per production of 3,000,000 pieces (Form C)	1200	0.25	300.00
Actual			
Per Form D	1150	0.26	299.00
Increase			
Due to increase in rate paid per hour	1150	0.01	11.50
Decrease			
Due to increased efficiency, as compared with standard	50	0.25	12.50
Net decrease..........................			$1.00

The variations in labor cost for the other departments are obtained in the same manner as illustrated above for the cutting department.

The importance of distinguishing between labor cost variations resulting from changes in the rates paid per hour and those due to variations in the productive efficiency of the operator is demonstrated in the comparison shown above for the heading department, where the actual cost totals the same as the standard and which ordinarily would be passed by, whereas the saving of $81 resulting from decreases in the rate per hour is offset by the decreased efficiency of the operators. In the illustration given it is assumed that the burden rate per hour of the cutting department is $0.30 while that of the operator is only $0.25, so though the employment of operators inferior to standard has not resulted in any direct labor loss the 50 hours taken over standard represent a burden loss of $15.

Burden.—The principles underlying the distribution of material and productive labor are simple and straight-forward as such expenditures can be directly applied to the operation or item of product manufactured, accordingly in the distribution thereof there is little difference among accountants as to the general rules to be followed. In the case of general expense or burden, however, it is not possible in the majority of cases to trace any direct relationship between the expenditure and the individual item of product, and the problem of providing methods whereby each article manufactured will be charged with a share of such expenditures in proportion to the benefits which accrue to it therefrom is an exceedingly complex one.

In the earlier days of manufacturing when little machinery was employed and that of a simple character, the question of proper methods of burden distribution was of relatively minor importance as the burden expense represented but a small percentage of the labor cost involved in the manufacture of an article. In these days, however, of machinery, expensive to purchase and costly to maintain, and where one operator may have charge of six or more machines at a time, the burden cost will often many times exceed the operating payroll. Accordingly the problem of burden distribution is very vital, and one upon the successful solution of which the prosperity or failure of a business may depend.

In spite of the importance of proper methods of burden distribution there are still found manufacturers who are content to figure the burden factor in their costs on some such crude basis as by adding to the labor cost of the article the same percentage which the total burden bears to the total productive labor of the plant, regardless of the fact that one item of product may involve 90 per cent. hand work, while with another the same percentage of work would be performed on expensive automatic machines. Such methods have undoubtedly been the basic cause underlying the failure of many a manufacturer and the salvation of more fortunate, but no less incompetent concerns, has probably often been due to the fact that their competitors were equally ignorant of the proper way in which to figure the actual costs of production, so that they all operated under the same handicap.

It is often necessary to introduce somewhat elaborate methods of burden distribution if even approximately correct costs are to be obtained. As an instance of the importance of such refinements may be cited a case where the methods employed were considerably in advance of those followed in the average concern and yet where the result obtained was very far from being correct. Here the burden was carefully analyzed by departments and distributed to the work passing through the department in proportion to the productive labor expended on the item of product. With a view to testing the accuracy of this method of distribution, a study was made of the work performed on some automatic machines as compared with that undertaken on a simple machine in the same department, the burden being distributed on a uniform basis namely as a percentage of the labor cost chargeable to the job. In the former case there were several expensive machines operated by one workman with an assistant. In the latter there was a simple inexpensive machine requiring the full attention of a single operator. The following statement shows in comparative form the more important distinctions between the conditions attending these machines:

AUTOMATIC MACHINES	SIMPLE MACHINE
One operator with an assistant can take care of as many as six machines at a time and figuring the payroll of these two at a total of say $6 a day gives a productive labor cost per machine of $1 a day	One operator for one machine with a daily wage of, say, $3.50
Relatively heavy tool expense	Relatively small tool expense
Relatively expensive maintenance of machine	Relatively low maintenance expense.
High power consumption	Low power consumption

It was found in the case illustrated above that the actual operating and maintenance expense (other than productive labor) per day on the automatic machines was at least three times as great as on the simple machine so, assuming that the method of distribution employed to result correctly as regards work performed on the automatic machines, as regards the work done on the simple machine the burden charged would be ten times and a half of what would be equitable. This conclusion is arrived at as follows:

> Assume that the daily cost (other than productive labor) of operating and maintaining the automatic machine is $3. The daily cost of operating the simple machine (which as stated above is one-third of the automatic machine) is therefore $1.
>
> The daily productive labor cost on each automatic machine is $1, therefore the cost of $3 a day for operating and maintaining the machine represents 300 per cent. of the productive labor cost.
>
> On this basis under the distribution plan employed, the daily burden charge to work performed on the simple machine would be 300 per cent. of the daily productive labor cost of $3.50, or $10.50.
>
> But as stated above it was found that the actual burden chargeable to the simple machine should be only $1 a day.
>
> Therefore, assuming that the method of burden distribution adopted is correct for the automatic machines, work on the simple machine is charged with 10½ times what it should bear.

The above is, of course, an extreme but not unusual case and illustrates the danger which lies in using averages in figuring burden in a plant where the work performed is not of a uniform character.

In the hypothetical case shown in Figure 3 there is a single item only of product being manufactured to which all expenditures must ultimately be charged and, considered from the basis of an exposition of methods of burden distribution to meet complex conditions, this illustration is imperfect by reason of excess of simplicity. Accordingly a description of methods of burden distribution suitable for a plant manufacturing an extensive and varied line of product will be deferred to later installments where accounting methods to meet such requirements will be fully described.

The situation reflected in Figure 3, however, lends itself admirably to illustrating an important feature in connection with burden distribution, which in the main is not dealt with in the voluminous literature on this subject. As was previously stated, the usual cost accounting horizon is limited to *costs* to the exclusion of *causes*, the work of the cost accounting department being confined to a distribution of actual expenditures without regard to their relationship to standards. Accordingly, no distinction can be made as between expenditures which result in full value being received and those which in large measure are wasted owing to incompetence and inefficiency.

In reality, the usual forms of cost accounting confine the records to one side of the ledger, very complete and elaborate analyses being made of the actual expenditures representing the debit side of the account while the credit side, showing the value of the services resulting from such expenditures, is omitted entirely. This one-sided form of accounting shows a similar lack of appreciation of relative values to that displayed by those plant superintendents who pay a great deal of attention to insuring that by no possible chance can an employee be paid for a minute more than the time he spends on the premises, but in the main overlook the question as to whether from the employer's standpoint the employee is profitably engaged during the period for which he is being paid.

It is a somewhat singular fact that under the accepted methods of valuing inventories at cost, it is perfectly proper for a public accountant to certify as to the accuracy of the inventory item on the balance sheets of two concerns next door to one another and manufacturing identical products, while owing to wasteful and inefficient methods the cost of manufacture of one is 20 per cent. more than the other, *so that as regards the inventory item at least it may be stated that the greater the inefficiency the more valuable the asset.* Of course no auditor would accept a cost valuation in excess of selling price if his examination disclosed this fact, as it doubtless would, but within limits the statement made is correct.

The far-reaching consequences resulting from what Mr. Polakov calls "this fatal misconception of what constitutes the cost of a commodity" are ably described in a recent installment of that writer's articles on "Mastering Power Production."[1] It is beginning to be realized that the wasteful and inefficient manufacturer is not his own enemy solely, but that of his employees and of the community at large. In the long run the ultimate consumer pays for all inefficiencies and the manufacturer who wastes material and human labor is to this extent contributing to the high cost of living, and hastening the day of the exhaustion of natural resources.

The obvious solution of the problem is, first, the determination of the necessary or standard cost of manufacture and, second, the separation of expenditures between those which are necessary and those which are the result of inefficiencies. As Mr. Polakov states:

> An accurate knowledge of the excess of expenses over the necessary cost of production leads almost inevitably to the discovery of means for eliminating this waste.

A somewhat elementary illustration of the operation of such a plan is given in Figure 3. Reference to the Summarized Manufacturing Statement (Form A), already referred to in connection with material and labor, will show that the burden expense is given both as regards the actual amount spent and the standard, as follows:

Actual burden	$10,019.50
Standard	8,808.50
Excess cost	$1,211.00

As every manufacturer knows, the burden charge to product tends to vary inversely to the volume of product, as a certain proportion of the expense included in burden is in the nature of a fixed charge not varying with the production, and this feature of burden costs is the underlying cause for the effort made by manufacturers to decrease costs by increasing production. In Figure 3, therefore, a distinction is made between these fixed charges and those of a fluctuating character, the excess of total actual burden over standard burden being analyzed as follows:

Fixed charges:	
Increase due to variations in expenditures	$787.00
Increase due to variations in production	129.20
Fluctuating charges:	
Increase due to variations in actual expense compared with standard expense	294.80
Total Increase	$1,211.00

In making the distinction between fixed and fluctuating expenses it is assumed that careful estimates were prepared of what the expenses should be in order to handle the estimated production of 3,000,000 bolts per month. A certain organization would be required to carry along this contract which would not be affected by minor variations in production, this also applying to rent, insurance, etc., and such expenditures would be included under the head of fixed charges. The expenditures coming under the head of fluctuating charges would be such items as tools, machine repairs and power which would tend to vary directly with the production. Foremen, carried on a monthly basis in this case, would be considered as a fixed charge.

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[1] INDUSTRIAL MANAGEMENT, October, 1918, page 321

As was indicated previously two factors would enter into variations between the actual and standard fixed charges, those resulting from the actual expenditures incurred being more or less than the estimates or standards and those due to the production being at variance from the standard or estimate of 3,000,000 bolts per month in all departments. The effect of the first of these factors is the loss of $787 shown above, which amount would, of course, be analyzed by classes of expense so that the increases could be localized and steps taken to eliminate them in future statements. As regards the second factor, reference to Form D on Figure 3 will show that whilst the standard production was realized in the cut-off department, the production of the heading, pointing and threading departments was 100,000, 200,000 and 400,000 short of the standard, respectively. This results in the expenses requiring to be absorbed by a smaller production than was estimated, or an increased cost as compared with standard of $129.20. The remedy for the plant manager to apply in order to eliminate this item of increase on the succeeding Manufacturing Efficiency Statement is obvious.

In the standard cost (Form I) burden is figured on the basis of a certain number of standard hours at a standard rate per hour. For instance, the standard burden cost for the heading department per 10,000 bolts is $13.50, obtained by extending 27 standard hours at a standard rate per hour of $0.50.

This standard rate of $0.50 is divisible into:

Fixed charges	$0.03 per hour
Fluctuating charges	0.47 per hour

The method employed in ascertaining variations between actual and standard burden is illustrated in Form E on Figure 3, the variations being figured as follows:

FIXED CHARGES:		
Estimated monthly expense for handling contract of 3,000,000 bolts (See Form J)..	$243.00	
Actual expense for month (Form E)....	250.00	
Increase due to fluctuations in expense...		$7.00
Standard hours on basis of 3,000,000 bolts per month (Form J)..................	8,100	
Standard hours earned on production of 2,900,000 bolts (Form E)..............	7,830	
Decrease in standard hours..............	270	
Standard rate per hour..................	$0.03	
Increase due to production being less than standard		$8.10
FLUCTUATING CHARGES:		
Actual expense for month (Form E).....	$3,962.00	
Standard expense for month 7,830 standard hours at standard rate of $0.47 per hour	3,680.10	
Increase comparing actual with standard..		$281.90
Total Increase		$297.00

CURRENT COSTS

In "Cost Reports for Executives" Mr. B. A. Franklin makes the following statement:

> This variation of the cost of the same article at different times constitutes the important point, not only in the proper understanding, but in the appreciation of costs. *The ability to master this point and to figure estimates or predictions of cost from a standard under varying conditions* gauges the comprehension or the meaning and value of practical costs.

In Form F on Figure 3 is illustrated the method by which current costs can be obtained by adjusting the standard cost to the basis of current conditions by the use of the ratios of actual to standard cost as appearing on the Inventory Account (Form H).

In Form H the adjustment factors for labor and burden are taken in total instead of by individual operations, a slightly different result being obtained by figuring the adjustments by the factors for the different departments. This is drawn attention to at this point in order to emphasize the fact that all costs must be more or less approximate however elaborate the methods of distribution may be, and in many cases time can safely be saved by using averages in place of detailed figuring, especially in the event that the figures used cover a period of several months so that variations in work in progress at the commencement of the period and the close are so small as to very little affect the final result. Of course, in a case such as that illustrated in Figure 3, where one very simple product is manufactured the figuring of each operation by its individual adjustment factors would be a matter of small moment, but in a case where it is necessary to adjust the standard cost of a machine which embodies a thousand or more parts such a proposition would involve a great deal of detailed work. With a properly designed system, however, standard costs can be easily and safely adjusted by the use of very few adjustment factors.

Standard costs can be used not only as a basis to figure costs under current conditions but also, as Mr. Franklin suggests, as a foundation on which to make estimates or predictions of costs. In this connection it should be noted that to obtain the fullest value from the use of standard costs calls for the exercise of the faculty of imagination on the part of the cost accountant. The ability to make intelligent forecasts will be an essential qualification of the cost accountant of the future, and the demand which will come for a wider range of ability on the part of the cost accountant cannot fail to result in the importance of his position being recognized, and its status raised from its present rather low point to one commensurate with the essential character of the functions it performs.

COST OF SALES

The method illustrated in Figure 3 (Form G) for ascertaining the cost of sales (or more properly of shipments) is the same as that previously described for figuring current costs, the standard cost being adjusted to the basis of actual conditions by the use of the ratios of actual to standard as appearing on the Inventory Account (Form H). Reference to Form G will show that the number of bolts shipped was 2,000,000, comparison between the standard and actual cost of these bolts being as follows:

	Actual cost		Standard cost		Increased cost	
	Total	Per 10,000	Total	Per 10,000	Total	Per 10,000
Material	$14,252.40	$71.26	$13,320.00	$66.60	$932.40	$4.66
Labor ..	2,775.17	13.88	2,628.00	13.14	147.17	.74
Burden .	7,066.98	35.33	6,210.00	31.05	856.98	4.28
Totals .	$24,094.55	$120.47	$22,158.00	$110.79	$1,936.55	$9.68

Comparison of the standard and actual profits on sales is as follows:

	Actual		Standard		Increase or decrease*	
	Total	Per 10,000	Total	Per 10,000	Total	Per 10,000
Sales..	$26,000.00	$130.00	$26,000.00	$130.00	....	.....
Cost of sales.	24,094.55	120.47	22,158.00	110.79	$1,936.55	$9.68
Net profit.	$1,905.45	$9.53	$3,842.00	$19.21	$1,936.55*	$9.68*

(To be continued.)

Mastering Power Production — X

Conservation of Labor, Power and Fuel in Relation to Rates

By Walter N. Polakov

This is the final installment of Mr. Polakov's *series dealing with the management of power plants and the control of power production. It takes up the important matter of economical production, the conservation of labor and the saving of fuel and supplies, all in relation to their influence upon the cost of current and the rate at which it is sold. In closing the author presents a powerful plea for economic preparedness to meet the conditions of the days of peace.*

Mr. Walter N. Polakov *is a consulting engineer specializing in the management of power plants. He was educated abroad, held a position of shop superintendent and chief engineer in Russia and was also instructor and consulting engineer to the Naval Academy at Baku. After coming to this country, and prior to taking up his own practice, he became a consulting engineer to the Board of Estimate and Apportionment for the City of New York, then consulting engineer for the Penn Central Light & Power Company and later on was superintendent of electric power of the New York, New Haven & Hartford Railroad Company. He is now devoting himself to private practice.*

THE success or failure in mastering production determines the future of Society, rise and fall of nations, the form, order and ideals of our relations. Upon those who are called to organize, plan, direct and control production, depends whether wastefulness, idleness and friction shall ruin the regime heretofore supporting such a state of affairs, or efficiency, industry and coöperation lead us to a higher form of social order.

Which way will be chosen in this or that case is not a matter of free choice, but an inevitable resultant of an interplay of a large number of social and economic forces. Those who are clearly gaining in the game of destruction of natural resources, benefiting by idleness and unable to foresee the outcome of the dissipation of human resources through a low standard of life and its corresponding ills—will, by the sheer logic of facts cling to and support privileges and competition. So long as the mastering of production rests in their hands, it is not the fact of the destruction of natural and human resources, but the figures of the ledger account that determine their attitude toward the conservation of life, fuel, materials and time.

Their mode of action cannot be other than arbitrary, as it comes from within being born by individual desire for profit, aggrandizement and unperturbed—"*apres moi le deluge.*"

Again, those industrial leaders who have enough foresight, either intutitive or based on a study of economic facts and tendencies, to get a clear vision of the coming "deluge," who for reasons of immediate patriotism or in anticipation of future advantages, are ready to denounce the unrestrained scramble for individual gain at whosoever and whatever expense, come out strongly in favor of coöperation and the abolition of special privileges, and wisely practice efficiency on a plan broader than any one plant, any one branch of industry or even any one state. Their method of mastering the production is thus permeated by the democratic spirit—since it is guided from without and based on facts forming the foundation of the economic structure of society—coöperation.

CONSERVATION OF MAN'S EFFORTS

The manager, management engineer or whatever name may be used has to formulate *the policy of mastering production, consistent with the fundamental principles or natural laws of social development,* as opposed to mere conformity with his personal view or fancy as to righteousness, legality, tradition, or what not.

As the word itself indicates, *management's function is the coördination of men's efforts,* and as such it involves:

1. Best procurable living conditions.
2. Highest degree of hygiene.
3. Broad education.
4. Vocational fitting.
5. Study of science involved in industrial process.
6. Acquiring skill in operations.
7. Fixing the useful habits.
8. Making work fascinating.
9. Minimizing dangerous and manual labor.
10. Increasing production per time unit.
11. Minimizing working hours.
12. Providing productive relaxation.

When these elemental requirements are complied with, the complex requisite of industrial economics *maximum production with minimum effort*—is fulfilled.

In the course of the preceding installments on the mastering of power production we have tried to show by the examples of one particular branch of production, even though the manufacture of power is and always was preeminently the domain of engineers, how considerable is the waste caused by uncoördinated, arbitrary ruling on managerial problems. We have restricted the scope of the discussion within the walls of power stations, formulating and illustrating sound principles of management guided by studies of facts and animated by a desire to apply the knowledge for the benefit of all, not for a few. Difference of opinions has no room where facts are established and experimentally proven. Similarly, no conflict of interests may be expected wherever the welfare of all is supreme; hence the fullest coöperation may be expected in an establishment conducted along these lines.

Any system of management upon final analysis appears to be merely a mechanism. Like all such, good use or poor use may be made of it; like any tool it may be applied to a right or wrong purpose, and so long as "scientific management" or any other form of management is applied merely as a panacea for boosting dividends, it not only falls short of accomplishing its social function, but on the contrary, creates friction and further antagonizes the interests of the benefited and benefactors. Yet no definite aim can be achieved without proper mechanism and the scientific method of controlling production seems to be particularly and admirably fitting to the aim of social mutuality of the coming industrial democracy. What we mean here as a mechanism is, of course, not an agglomeration of short cuts, stunts and universal remedies for this or that industrial ill and waste, but an organically whole philosophy of industrial coöperation for production carried forward for the common good. Real mastery of production presupposes a profound knowledge of the involved science and technical experience, but it cannot be practiced successfully in an arbitrary, dogmatic fashion. No authority of those directing production is capable of justifying the issue of an instruction, calling for dilution of acid by adding water, yet in dealing with human relations, orders sometimes unhesitatingly are issued and enforced that are fraught with equally dangerous consequences.

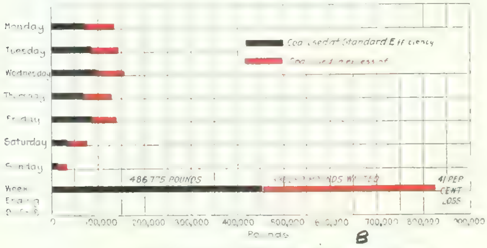

FIG. 42. CHART SHOWING COAL USED AND ALLOWED

The conservation of fuel cannot be brought about by orders and appeals, nor by compulsory or voluntary installations of fuel saving devices and improved machinery. The desire to save fuel on the part of those who actually use it is insufficient, unless supported by a knowledge superior to the one prevailing. Special care and attention and extra efforts are capable of producing little unless means are provided to watch the results, yet a monthly compilation of statistics in a centralized bureau does not show "why" to those causing the waste through ignorance, fatigue or managerial handicaps. Moreover, long working hours, low wages, the employment of untrained men, low intelligence, negro help, etc., must be done away with before fuel conservation can be seriously attempted. Similarly, all the coal saving devices and appliances may produce results only if properly used, while if neglected, misused or abused, they cause a direct harm by wasting labor and material for the manufacture of something that is not properly put to work. Automatic equipment and apparatus are, in fact, frequently worse than none, since dependance on their work and regulation promotes a sense of security and care-free spirit with a common consequence of additional losses "coming and going" with each variation of furnace and load conditions, while, again, an endless number of examples proves the superiority of intelligent manual regulation. All this, of course, applies only to the average cases and does not imply the abnegation of intrinsic values of such devices and improvements, which simply fail to serve incompetent users. Any national campaign for fuel conservation will fall short of desirable results unless every individual plant coöperates with the fuel administration, actually and not in form only.

A MANAGER'S QUESTIONNAIRE

Let every plant owner or manager frankly answer to himself the few following questions and then act accordingly:

1. How many pounds of steam or kilowatt hours are produced *actually* with one pound of coal on the annual or monthly average?
2. How many pounds of steam or kilowatt hours is one pound of fuel *capable* of producing in the existing equipment?
3. To what is this shortage due?
4. What does this loss amount to per year? (In dollars to the plant and in tons to the country.)
5. Do the employees know how better to utilize fuel?
6. Are they willing to learn?
7. Who can show them and help them?
8. Is all the steam generated productively used?
9. Is all the power generated productively used?
10. May the purchase or sale of power improve the fuel economy?

Such a questionnaire may be elaborated extensively but in a predominating majority of cases no answer to the first question is to be had, and whenever this is the case, the efficiency of boiler operation generally is in the neighborhood of 50 per cent. and the fuel losses are likely over 30 per cent.

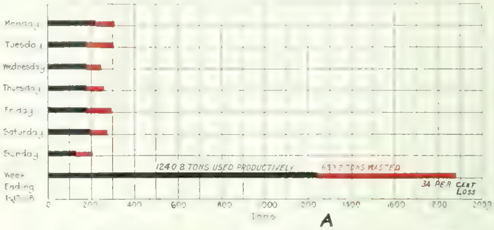

FIG. 43. PROPORTION OF COAL BURNED TO THAT ALLOTTED

A few charts (Figures 42 to 44) show conditions as found in a number of power plants, both industrial and public utilities, many of which for a long time enjoyed the blessed ignorance as to real conditions.

The Connecticut Committee on Fuel Conservation does not hesitate to remind that "it practically amounts to TREASON to waste coal at this time," yet without coöperation between plant management and fuel administration no better results may be expected than from an army where every soldier feels at liberty to carry or not the plans of the general staff. *Every plant consuming a large amount of fuel should keep a daily fuel chart showing in "black" the amount of fuel sufficient for the productive work done and extend the line in "red" to show the total actually consumed.* In other words, the black line representing the task and the red representing the waste, tell the story at a glance. Unbiased and competent investigators, after due tests and studies, can correctly determine for each plant under observation what amount of coal is a reasonable allotment.

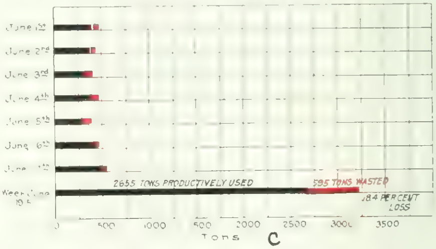

FIG. 44. TYPICAL COAL CHART OF EFFICIENT PLANT

For instance: plant A generates electric power for sale and with the equipment it has and character of load it handles, 16 pounds of steam per 1 k.w. hr. is reasonable, while steam may be generated at a ratio of 8 pounds per 1 pound of coal. Thus this plant's allotment would be 2 pounds of coal per 1 k.w. hr. on a day when 300,000 k.w. hr. were generated, and 600,000 pounds of coal would be the permissible quantity, yet actually 930,000 pounds were burned.

Plant B furnishes steam to a factory for a variety of purposes and can produce 9.2 pounds of steam per 1 pound of coal. On a day when 550,000 pounds of steam were consumed 60,000 pounds of coal should have been enough, while actually 77,000 pounds were used.

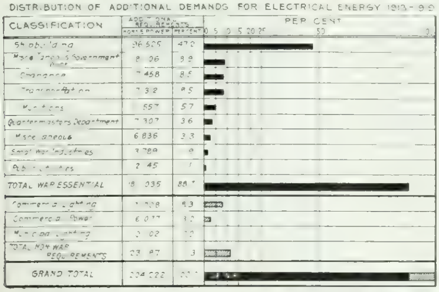

FIG. 45. FORECAST OF DEMAND FOR ELECTRICAL ENERGY

Such records, totalized by weeks and months, tell the story of progress made, stimulate coöoperation and cases of glaring wastefulness may be promptly investigated and expert assistance summoned. The principle suggested to the United States Fuel Administration at the last annual meeting of American Society of Mechanical Engineers[1] is to abolish the privilege to waste fuel in inefficiently conducted plants, by giving priority in coal deliveries to those that prove that they do use it efficiently. This principle is now taking a definite form of rating plants into five classes and the needlessly wasteful ones would be the last to draw upon the available supply of fuel.

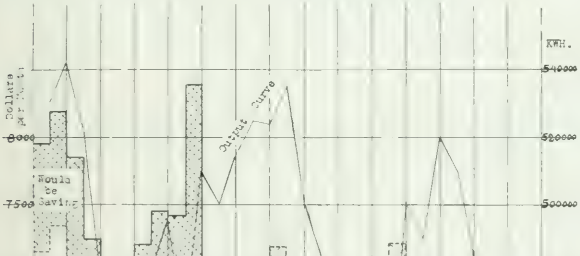

FIG. 46. COMPARISON OF COSTS OF CENTRAL STATION AND ISOLATED PLANT SERVICE

Now, suppose that the most extravagantly wasteful plant furnishes power for the most needed public purpose, transportation or manufacture of an imortant commodity. To leave it without fuel supply may amount to a calamity; to leave it alone because of the importance of its function means to protect waste, incompetency or what not. The autocratic way would be to choose between the two and thus cause public loss to the country one way or another; as opposed to this, a true democratic way is to offer coöperation, "call for a doctor" as the case may be and as excessive "red" on the charts clearly indicate. A study of the causes of inefficiency discloses a more economical way to manage the plant and the plant should have the benefit of such disclosure. If the management is unwilling or unable to do better, it is not a remedy to close the plant and thus reduce the productive capacity of the country. The selection of more competent management is in such extreme cases a solution capable of satisfying both fuel conservation and unhampered production.

Bill to Turn Power Stations Over to the President

Realization of the fact that a large majority of our public utility plants are running wastefully caused the preparation of a bill giving to the President the authority to acquire, control, build, and operate steam and hydro-electric plants and so forth. If this is to become a law it would serve as a step toward the nationalization of the power industry which, if consistently carried out, is but a higher form of coöperation. We never heard of postmasters advertising to boost the sale of postage stamps in Brooklyn to take away business from New York, or of the Railway Administration soliciting patronage, yet we were in the habit of doing those things regarding light and power and other commodities at the expense not only of the consumers, but of the country at large, since the productive manpower of solicitors, advertisers, printers, paper and ink makers, etc., is diverted to occupations the necessity of which is created merely by a competitive, destructive system of ownership.

The secret of the situation lies evidently in the fact that the production was carried out not to satisfy wants and needs, but to make profit. When the requirements created by war overtook the productive ability, there was nothing left to the salesmen but to apply their energy to some other activity, and the government took heed to the iron logic of facts by wiping out the middlemen's commission on railroad and some other supplies. Carefully compiled statistics and graphical representation showing the requirements for certain commodities and progress in their production are gradually taking the place of the anarchy that reigned supreme in throwing on the market unregulated output at haphazard intervals. The output of steel, brass, bed-steads, ships, wheat flour, electrical energy, is regulated by demand forcasts. (See Figure 45.)

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[1] See my discussion of Mr. D. M. Meyer's paper, Journal A. S. M. E., February, 1918.

Isolated and Central Station Controversy

The unorganized competitive system was lacking the first prerequisite, a mechanism for coöperative coördination of production. Gantt's charts blaze the way. Yet the idea of coöperation was neither unknown nor inoperative. Socialists preached it, big trusts practiced it. But a process of such gigantic, sweeping nature is slow by necessity; to be specific within our topic—we are still watching the fight between central stations and isolated plants; we still see electric railways serving central stations' interests; we have not learned as yet how to shake off the spell of the "devil taking the hindmost" but we were forced to take the new road before some of us realized where it leads to.

The old controversy between the isolated and central stations is not a conflict between the antiquated, inefficient mode of production and the modern, large-scale economical productive management, as some tried to represent it. The antagonism was almost exclusively the desire on the part of the central stations to secure for themselves the benefits of a better diversity factor and to extend the market. In the race for this goal, much effort was exerted to obscure the value of exhaust steam which as a by-product of isolated plants furnishes heating and steam for processes in many cases, whereas if electric energy were purchased, it would require practically the same amount of fuel and the same expenses to generate steam without getting mechanical or electrical power from engines replaced by reducing valves. Moreover, the propositions made from time to time by engineers to combine the operation of central and isolated plants were hotly battled down, though by taking central plant service during the seasons when exhaust steam would go to waste, and operating isolated plants when steam is to be generated anyway, the central stations would get a benefit of such coöperation, reducing idle overhead charges in summer months and dropping off extra load during the winter peaks, while the isolated plants would save a large quantity of fuel for the country. Fuel conservation, increased capacity of public utility plants for industrial purposes, and other advantages might have been derived from a careful study of such and similar individual cases. On the other hand careless, incompetent operation and maintenance of many isolated plants is so glaring (chiefly due to the lack of understanding and interest on the part of their owners engaged in quite different pursuits) that it takes little cunning on the part of solicitors of new business to present convincing figures of momentary advantages of central station service over slip-shod mismanagement of some isolated plants.

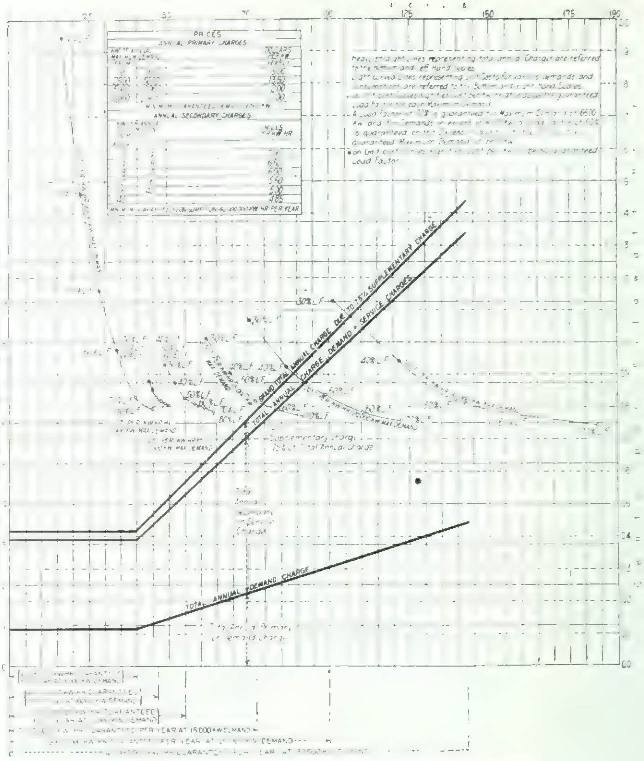

FIG. 47. GRAPHIC ANALYSIS OF CONTRACT TERMS

Figure 46 illustrates a typical case where tempting rates of purchased power would have meant a serious loss to the isolated plant if the central station service was contracted. Instead of that, the owners of the isolated plant put their own plant in order, saving much coal and more in self-respect, proving themselves to be capable of managing their own undertaking. A typical example of the adjustment of rates to the terms of a contract for purchase of electrical energy is analyzed graphically in Figure 47. The much heralded reduction of rates with increased consumption does not make itself manifest in this case. The once famous practice of discrimination between small and large customers of public utilities, whereby the brunt of financial obligation of the company falls on residential and small customers, whereas the large industrial consumers get the energy more nearly at cost, has many reasons advanced both *pro* and *contra*; but the fact that while about 5 k.w. demand of the residential consumer requires only one k.w. capacity at the plant, whereas 5 k.w. demand of the industrial consumer calls for 3 k.w. in the plant, due to different diversity factors, is generally carefully obscured by all kinds of side issues. It is plain, nevertheless that in one case the financial obligations of the utility company's plant are six times as large per unit of energy sold, as in another. Similar relations exist in the carrying capacity of lines and conduits.

Suggestions have been made at different times and from various quarters, to readjust the method of rate setting on the basis of actual (average for the company) cost of service plus profit, which in a general case means the three-rate system: First, charge for energy consumed; second, for generating, transforming and transmitting equipment tied up; third, for individual services to consumers, such as meter reading, bill-

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Boston meeting A.S.M.E., April 5, 1917. Hearings Public Service Commission, New York, 1918.

ing, etc. While some of the utility companies through adoption of this or a similar plan were able to materially reduce the rates and secure as a consequence larger load and better diversity factor, considerations as to cost of off-peak load introduce a new light on the subject. It is obviously to the advantage of the company to absorb the fixed charges of idle generating equipment by putting it to work. In doing so it might be found under the circumstances more desirable to sell the energy at less than cost, yet materially reduce the idle charges. With the possibility of nationalizing all public utilities the rate question must of necessity undergo some radical changes.

To the railroad it costs more to bring the passenger from a suburban town into a metropolitan terminal overburdened with high rental, than to carry him ten times the distance elsewhere. To the Post Office to ship a sack of mail from coast to coast involves larger expense than to a less remote destination. The rate, however, remains three cents per mile and three cents per ounce of a letter, irrespective of other variables, the average diversity factor of which, balances up the differences in cost to one uniform rate. Obviously such practice could not work very well with an individual company serving limited territory, or even part of it, as the opportunities for one class of consumers to take advantage of the other would create very serious complications, while in case of neighboring territories dissimilar in the character of service required, legal and statutory regulations, etc., served by independent utility companies, the difference in the uniform rate of each would give rise to still more profound difficulties.

Whatever are the causes of higgling the rates for power, and what remedy will be eventually applied, neither our economists nor the practical business managers and financiers are able to explain them away, so long as they cling to medieval theory of supply and demand and to the fallacious assumption that there is a certain "wage fund" appropriated to the payment of wages compared with the number of laborers. As in the case of any commodity, the value of labor power (its production and reproduction) defines the cost of production, whether this labor-power is applied in the power house or coal mines, or shops, building equipment and supplies, or schools. Modern industrial relations being so intricately interwoven one cannot fix the price of electricity or labor without either stabilizing the entire market or readjusting, balancing, juggling, correcting, equating and so forth constantly here and there. A recent bulletin of the National City Bank admitted that "the future of wages, prices and values in general will depend upon harmonious, highly organized, efficient, well balanced industry, creating new wealth at a rate sufficient to satisfy the growing wants of the people."

This means nothing less than a consistent application of the principles exposed in this series. Under the strain of war-time we still excuse ourselves of competition, disorganization, wastefulness and unbalanced production, yet, "After the war comes the period of reconstruction as after death—the Day of Judgment" and the obligation of preparedness for peace is even more serious than it is for war.

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Instructions to Assistant Foremen

Prepared By a Plant Working Extensively on Governmental Orders to Inspire and Guide Minor Executives

By George H. Shepard

In a readable, direct manner these instructions were prepared and issued by the works manager to help in the orderly, economical production of work. Especial emphasis is laid on the point of the relations between foremen and workmen; and foremen are counselled how to handle various kinds of workers, arouse their patriotism, win their coöperation, reward their service and employ their particular abilities to the fullest extent.

Mr. George H. Shepard *served seven years in the navy, exclusively in engineering duty, after having been graduated from the United States Naval Academy. He retired from the service and took up educational work, having been on the faculties of Cornell and Syracuse Universities, and becoming dean of the engineering college of the latter. He resigned to become a member of the Emerson Company, and after three years established his own consulting practice. At the outbreak of the war he immediately gave up his practice, returned to the navy and is now on naval duty.*

INSTRUCTIONS TO ASSISTANT FOREMEN

THE following instructions to assistant foremen were prepared for a large plant which is occupied exclusively with government work. This plant is now employing more than three times as many workers as it did the winter before the United States entered the war. This increase has made it necessary to appoint a large number of new supervisors. The general foremen and foremen, where new ones were necessary, were provided by the promotion of supervisors of lower grades. But many of the new assistant foremen had had no previous experience in supervisory work, and instructions were prepared to help them with their new duties.

As a similar situation exists in many other plants, the following instructions are offered as a suggestion to those managers who are obliged to use a large number of inexperienced supervisors. Of course, these instructions will have to be modified somewhat before they can be issued with the best effect in any other plant, because they should vary with the local circumstances, but the points covered are all basic.

In the plant for which they were prepared their form was much influenced by the facts that the plant does jobbing work exclusively on distinctly war materials of a very wide variety and with very little repetitive work, and that general betterment measures were only partially developed in the plant, as a whole, when they were issued.

I am indebted to Mr. Will H. Smith and to the general foremen of the plant, for valuable aid in preparing these instructions.

The Instructions

The management realizes that, in what follows, it is handing you rather a large order.

However, in advancing to the grade of assistant foreman, you have stepped up out of the mass and have begun to climb the ladder of advancement. If you are to continue to advance, it can only be by accepting larger and larger orders at every upward step, and filling them satisfactorily. Therefore, your personal hopes for the future largely depend on the way you take these instructions and live up to them.

On the other hand, the management believes that much of our work is under supervised, and is willing to provide additional supervisors wherever it is satisfied that their services will be a paying investment. In this connection a letter is being sent to general foremen, asking them to report needs for more supervision.

These instructions are not intended to cover everything that an assistant foreman needs to know; but merely those things which experience shows to have more or less escaped observation, and some things of such importance that they cannot be repeated too often, though every individual will probably find matters herein on which he personally is in no need of instruction.

In all of our work all of us should seek: Quality, quantity, and economy of production.

After our work is delivered to the government, the lives of our sons and brothers and the fate of battle depend upon its meeting every demand that is made upon it. Therefore, its quality must pass severe inspection and test.

If our work is not sufficient in quantity, the men at the front will be seriously, perhaps fatally, handicapped in their struggle with the enemy.

This war is one of resources. We have the greater resources; but, if we waste them, we may lose to an enemy who is justly famous for his efficient use of every man and every scrap of material. Every failure to produce economically is waste and by that much diminishes our chances and increases those of the enemy.

The following instructions are intended to help you to produce economically enough war materials of the required quality.

Why You Have Been Appointed

You have been appointed an assistant foreman not only because the management considers you an especially skilled workman, but also because it believes you will make a good executive, a good handler of men.

You should strive to maintain and increase your skill and your knowledge of your trade. You should make even greater effort to learn how to understand and control your men, to direct them effectively. Every man under you has his peculiarities. You must know them and how to deal with him individually, if you are to get the best results. Your success as an assistant foreman will depend largely upon your success in handling your men.

American workmen cannot be driven, but they are very responsive to good leadership. Therefore, it is your duty to be in fact, what you are in name a *foreman*; that is, a man who is always to the fore, leading his men.

In order that you may be a real *leader* and that your men may willingly follow you, you must earn their *respect* by being thoroughly competent and thoroughly honest with yourself, your men and the management, and by maintaining a strict but thoroughly fair discipline, and *good will* by being kind and interested in their welfare, by protecting them from work dangers and by being appreciative of good work.

Duty to Teach Patriotism

You yourself realize that we are fighting a war of self-preservation against an enemy more cruel and ruthless than the Indians whom our fathers fought. You realize also that it is only because he cannot, that he has not done to us what he has done to the Belgians, Poles, Serbs and Armenians.

It is also your duty to impress these facts upon your men. When a man thoroughly realizes what German victory would mean to him and his family, he needs as little to be urged to support the government in this war for his protection, as he would need to be urged to swim, if he fell overboard in deep water.

To be successful in dealing with your men you must be absolutely fair and square with them. Inside the plant and in working hours personal feelings must be absolutely forgotten. You cannot play any favorites or hold any grudges and succeed in handling your men. Almost all men will welcome strict discipline from a boss who is absolutely fair and square; and they will not only welcome it, but will support you against the few men who are not square.

You should not stop with being impartial with your men, but should be interested in their welfare and advancement. When you have taught a man so that he is capable of good work in a higher grade, you should seek to have him advanced to it. If you have no opportunity for him in your own gang, you should, if possible, secure his advancement somewhere else. No matter how big a loss he may be to you, you will gain more by the added enthusiasm and loyalty of your other men, than you will lose in him.

Unfortunately, there are a few men who do not respond to good treatment. These men respect nothing but force and can be ruled by nothing but fear. You will have to count on your share of these in your gang. When you get a man of this kind, the best thing to do is to get rid of him as soon as you can. But so long as he is with you, you must give him what his nature requires. Therefore, you cannot expect to succeed by kindness and pleasant words alone. You must remember that you are the boss and require your men to obey you. If they do not you must report them for discipline.

However, the number of men who require this kind of treatment is so small that you are not really a successful supervisor, if you often have to resort to such measures.

You are not really a good supervisor, unless you make your man loyal to you and to the government which you represent. This is to be done by setting them a good example in every way, by being absolutely fair in your dealings with them, by being actively interested in their welfare, and by seeking every opportunity to inform them about the cause of the war, what we are fighting for and why, and the terrible consequences if we allow ourselves to be beaten.

Importance of Personal Example

Your personal example is very important. You cannot expect your men to be punctual, if you are tardy; you cannot expect them to be diligent, unless you are more so; you cannot expect them to be loyal to you, if you criticize your own superiors; you cannot expect them to show a coöperative spirit, if you knock your fellow supervisors; you cannot expect them to be good Americans, unless you are a red-hot one.

Every man in the organization should appreciate the need of team work. The meaning of team work is well illustrated in baseball, in which every player works, not for his own personal score, but for runs for the team. The opposite of a good team worker, a grandstand player, who seeks to win applause for his own skill, regardless of its effect on the work of the team, is a hindrance to the country in the war, as he is to the team on the diamond.

Your Own Skill

Your superior skill in the work of your gang is valuable, not only in itself, but also as a means to the respect of your men, and therefore as a means of obtaining their willing obedience.

In order to maintain and increase your skill you must have: A mental knowledge of your trade, and manual skill in its work.

All trades are continually progressing. If you are not increasing your knowledge of your trade you are losing ground relatively to other men and, sooner or later, will find yourself a back number. What are you doing to increase your knowledge? Do you regularly read any good technical paper? If not, you ought to begin. It will almost always be found that the man who has risen in his business has given a considerable part of his leisure to the systematic study of it.

How can the management help you to a better knowledge of your trade? Do you know of any shop that does especially good work in your line? Do you feel that your usefulness would be increased by your being allowed to visit it? If so, ask your general foreman to recommend to the works' superintendent that you be ordered to make the visit. The management cannot guarantee to meet your wishes at all times in these respects; but will be glad to hear from you and will do all it can to give every man full opportunity to increase his skill and earning power.

Do you need instruction on any subject? For example, do you read blueprints readily and accurately? If you need instruction, report the fact, and the management will, if possible, provide for you in the educational work that we are starting.

You are in some danger of losing the manual skill upon which your ability as a wage earner primarily depends, by ceasing to work with your own hands. You should seek to overcome this by being, not only a boss, but a teacher to your men. You should watch for every opportunity to increase the skill of the men under you; whenever you see an opportunity to teach one of your men anything, it is an important part of your duty to do it. You never really know anything yourself until you have taught it to somebody else. By continually teaching the men under you the skill of your trade, you will not only maintain, but will increase your own skill.

Also as a man of superior skill in your trade, it is part of your duty to develop the same skill in the men under your orders. It is expected that you will be able to show even the best of your men something about your work. Beside this, you have men who are specialists only. In our work it will probably be impossible for you to use them on their own specialties exclusively, though you should do so as far as possible. Whenever work is slack in their own special lines, you should try to broaden their knowledge and skill, in order to develop them into the all-around men who are most useful to us. Beside these men, you should try to develop your men of the lower grades, so as to improve them and fit them for promotion.

Educating Your Men

If you have any man who would profit by instruction other than you can give him yourself, report his name to your immediate superior, with a recommendation that he be given the benefit of the educational work that we are just starting in this plant.

The duty of instructing your men may be more than you can handle alone in addition to your other work. If so, report the fact, and the management will, if possible, give you the help of a skilled man as an instructor.

It is an important part of your work to see that your men have conditions right, so that they can work to the best advantage and with as little waste labor as possible. This matter includes everything from attention to the health and safety of your men, to keeping their tools in good condition. Under the first head, you should be in full sympathy with the work of the safety engineer, and should coöperate with him in every way to reduce to the lowest possible point the risk to health, life and limb involved in your work. This work is one of great importance for the conservation of labor at a time of great scarcity; but, aside from that, it should appeal to every one purely from our general interest in the welfare of our fellow men.

Improvement in Preparations

Under the other head, there is no limit to the possibilities of improvement. Are your tools and equipment right? Are they in good condition? Can you get them when you want them? Have you enough of them? Are tools and materials as conveniently located as possible for your work? These questions should never be out of your mind during working hours, and you should do your best to correct any defects.

Many of these defects you cannot correct by your unaided efforts. In so far as necessary to secure help, take them up with your superior, or with the staff man concerned, the safety engineer, the despatcher, or the inspector, for example, or bring them up at the supervisors' meeting which you attend.

These meetings were started on purpose to give you a chance to bring such matters to attention. Everyone who is called to one of these meetings has a right to the floor, and a free discussion by all present of all points of interest, is in order. Your recommendations and suggestions are especially invited.

The management is largely dependent upon you for its knowledge of working conditions and will welcome your suggestions for their improvement. Your close contact with the work causes you to know many things, which those charged with general duties do not have a chance to find out except through you. If your tools are of poor quality or not kept in working order, if your work is delayed by lack of materials, if your men are exposed to unnecessary risks, if in any way your working conditions are not what they should be, or, if you see any way to make them better, no matter how good they are already, it is your duty to inform the management. You can do this by reporting the matter to your immediate superior, or to the staff man immediately concerned (despatcher, inspector, and so forth), or by bringing the matter up for attention at the weekly supervisors' meeting which you attend.

It is also your duty to encourage such reports and suggestions from your men, and to pass them on by the same channels as suggestions of your own. *In so doing never fail to give credit to the man who originated the idea.*

REWARD GOOD SERVICE

As far as it is in your power, you should try to reward those of your men who deserve it.

A word of praise from the boss goes a long way. Too much praise, indiscriminately bestowed, loses all value. But you should not be like those who are afraid ever to praise any one for fear of sometime commending some one who does not deserve it. Especially in these times, when every conscientious man is striving in his own way to strengthen the common defense, which is also his own and only defense against a cruel enemy, those who do their duty well value the recognition of it by their superiors.

When men in your gang deserve more substantial reward, you should recommend them for it. This will usually be in the form of advancement to a higher grade, and you should do all in your power to secure such advancement for those who are fit for it.

The management regrets that at present it has no means to reward good suggestions, except to note them on the maker's record and it will cause this to be done. It is hoped that every employee of this plant will sufficiently appreciate his duty to the government, to give the benefit of his ideas, even if he cannot hope to be adequately rewarded.

The management requests also that employees will not be discouraged, if they do not see results from their suggestions. Under war pressure to get out work immediately needed, it is often impossible to spare the time and labor to carry out even good ideas. In many ways the strain of war obliges us to improvise and to make shift the best we can. The utmost exercise of your ingenuity in these ways, both in the handling of your own work and in suggestions to the management, is one of the most valuable services that you can render.

The management has already received more suggestions than it can put into effect, but desires to continue to receive them, because others that are capable of immediate application may come in at any time.

ENCOURAGE SUGGESTIONS

The management is keeping a file of all good suggestions received, and hopes ultimately to make good use of all of them.

Any effort at improvement is on trial, until it has demonstrated itself as a practical success. A candid report from you on the value of any such attempted improvement will always be welcomed. At the same time remember that it is natural for men to stick to old ways and therefore new things are often turned down without a fair trial. Therefore, beware of prejudice against new things and give them a fair trial.

In industrial plants in this country men are usually trained as specialists rather than as all-around workmen. The war has brought into our plant many men from elsewhere, who may be very good at their own particular lines of work, but who have not the general knowledge of their trades to which we are accustomed.

Also many of our new men have hitherto practiced their trades under very different conditions and are, naturally, most skilful in work which most resembles that of their previous experience. You ought to encourage your men to tell you in what lines they are most skilled, and you should seek to use them along those lines as far as possible. In the wide variety and continual change of our work the management recognizes that this will not always be possible, but you should have it in mind and work to it, whenever you can.

A man may be altogether misplaced in your force, but may be a valuable man elsewhere. In the present scarcity of labor, a man who has a good disposition and sincerely tries to make good, should not be lost from our employment without every opportunity to find the work for which he is suited. Therefore, if a deserving man does not make good at your work, you should question him as to his previous experience, likes and abilities, and should recommend his transfer to other work for which you believe him to be better suited.

BEWARE OF ENEMY AGENTS

On the other hand, remember that the enemy is continually trying to place his agents in our employment and that these agents will make trouble for you and us in every possible way. Such a man may show up in your force at any time. Therefore, be continually alert for such snakes. When you think that you have found one, do not show him any sign of your suspicions, but report the matter promptly and confidentially.

CHECK UP EVERY MAN'S OUTPUT

Your own practical experience and skill in your trade has given you a knowledge of its quantities. If a man wastes material, you should know it by a comparison of what he has done with what he has used. If a man loafs on the job, you should know it merely from seeing what he has accomplished while you have been busy elsewhere. As soon as your men realize that you know these things, they will class you as a man that can't be fooled, and even those who have the disposition to deceive you will not try it, and you will find it unnecessary to watch your men closely in order to obtain faithful work.

When work is assigned to you, you should go over the job and have all obstacles removed. For example, have wiring moved, chipping or drilling done, joiner work attended to, and so forth, see that material has been provided, then show your workman the job, how you want the work done and where the material is, provide him with the order (job order or service card) and satisfy yourself that he thoroughly understands the job in all its details. You then have only to visit the job at intervals according to your judgment, to see that progress and workmanship are satisfactory.

It is a very important part of your work always to be planning ahead and getting things ready in advance.

HOW WORK IS DESPATCHED

In shops in which despatching by the service card system is fully developed, you will find in the top clip of the card holder at every work station, a card giving the necessary orders and information for the work which is then in progress or immediately to be started at that station.

In the lower clip you may find several cards for jobs that are to follow. These cards are arranged in the preferred order of the work, with the next card on which work is to be started in front, the next to follow next behind that, and so on. You should follow this order, if possible, in getting out your work, but you have discretion to vary it, if there is sufficient reason to do so.

Whether by service cards or not, you will have orders in some form as to the work ahead. You should always be looking ahead to have materials, working force and tools ready to undertake work at the required time.

It is intended that the despatch office shall relieve you of all details of advance planning. Therefore, as soon as you foresee the need of materials, tools, working force, transportation or anything else needed in preparation for a job, report the facts to the despatch office of your shop, if there is one. If the despatch office fails to take care of you, report the fact to your immediate superior.

Attention to advance preparation will help you to manage your working force. Most men will give you a good day's work, if they see the work ahead for them to do. On the other hand, men can neither be driven by fear of punishment nor induced by hope of reward to work diligently if they seem to be running out of work.

You should aim to keep every work station supplied with a next job as far in advance of the completion of the job in work as practicable. You should also keep watch of completed jobs to see that they are promptly inspected and moved away.

Move Work Expeditiously

After workmen have been urged to get out a rush job and have responded with their best efforts, they become very much disgusted, if it is allowed to lie around unused, and it becomes very difficult to arouse them to coöperation. Therefore, promptly move your completed work on its route, as far as this is within your authority.

If you are unable to provide for any work expected of you report the fact to your immediate superior as soon as you discover it.

Another important element of planning is to combine jobs so as to use set-ups, and so forth, to the best advantage. In shops which have despatch offices, it is an important duty of the despatch force, to combine jobs in this way. In this case it is your duty to put through the combination of jobs ordered by the despatch office and indicated to you by the service cards.

Another important element of planning is to maintain a balance between your force and your work, and among the different elements of your force. You should look ahead to see whether you are going to have too few men or too many men.

If your force is going to be overloaded, you should report the fact to your immediate superior and ask him to provide you with more men. If your force is going to be underloaded, you should also report the fact to your immediate superior, in order that he may either get you some more work or transfer part of your force to other work. *It is one of the worst faults that an assistant foreman can have to hang onto idle men, merely to gratify his vanity by having a large force under his orders.* If your shop has a despatch office, you should also report an approaching overload or underload to the chief despatcher, in order that he may adjust the plans of his office accordingly.

Keep Your Force Balanced

Another important point for you to watch, is to see that your force is composed of the right proportion of the different grades. If you have too many mechanics in proportion to helpers and laborers, your skilled men will be doing helpers' and laborers' work, while the country will be losing the production of the mechanics on the skilled work that they alone can do. If you have too many unskilled men in proportion to the mechanics, they will be waiting for the mechanics to provide them with work. In consideration of the fact that Department 83, plant laborers, is always short of men, it is especially desirable to avoid this condition. Unskilled men not needed in their own shops, can always be used by Department 83.

If your department has a despatch office, do no work without a service card, unless the job comes under the following exceptions:

A job that will take less than one hour and that arises from one of the following causes:

A. Request from men from outside your own department.
B. Failure of the service card to cover all the work you find necessary.
C. Request by another supervisor of your own department to have an odd job done for him.
D. Work you have done returned to you, or work from another part of your department sent to you for alterations.

If your department has a despatch office you should see that work is performed as directed by the service cards. You should carefully read service cards and note all information. If a card appears to be incorrect, you should refer it to your immediate superior, or to the despatch office. You should train your workmen to depend on service cards and should encourage them to call attention to cards made out wrong. Many good suggestions along this line have already been given by the mechanics.

Remember

Always remember that you are the representative of the United States and that the will of your country fails, unless you finally transmit it effectively to the men under your orders.

.........................,
Works Superintendent.

* * * *

Working Schedule for a Time Limit Job

By Donald A. Hampson

Mechanical Executive, Morgans & Wilcox Manufacturing Company

It is sometimes said that there is very little system in small and medium sized machine shops catering to contract work. This may be true to an extent but on the other hand it must be considered that these shops are not in the position of the large plant that can to a greater extent pick and choose its work, dictate terms and deliveries, and maintain at all times enough of the same kind of work to keep machines set up and men engaged without frequent shifting around. The medium sized shop often has to take what the large one refuses to bother with, while its charges must be

	Small Core	Small Ring	Large Core	Large Ring
Pattern	5	4	6	4
Casting	3	3	4	4
Turn	3		4	
Bore		5		6
Plane	4		5	
Drill	1	1	1	1
Assembly	4	4	6	6

FIG. 1. DIVISION OF LABOR

based on the larger plant's quantity figures. To make a success of such work there *must* be system in the smaller plant, usually in the shape of able management.

One of these smaller plants took a contract to make a complete set of molds for two sizes of tires to be used on some army trucks. Delivery dates for each size were set, with a penalty for non-performance. Each mold was of conventional form—inside collapsible core and outside ring divided for removal—but the particular features of this tire added considerably to the machine work and assembling.

As there were several conditions unfavorable to quick delivery, the company's engineer made a careful investigation of them and plotted a schedule to overcome them before the contract was signed. The few hours spent prevented what would have been a decided loss if the work had been started blindly.

The conditions that would slow up the work were as follows: The largest lathe in the shop was 40-inch swing. This was big enough for the cores, but as it was the only lathe of that size both cores must be turned on it, one after the other. Another shop in the city had a 48-inch lathe and permission was secured to use that for the rings, but this plant was to close for its annual vacation right in the middle of the working period. The shop had a big planer and a radial drill but only one of each of capacity to suit the work. Thus there were four machines where any conflict must be avoided, yet these machines must take the work in the natural sequence of operations. The size of the castings was above that of the shop's foundry and arrangements had to be made with a jobbing foundry to do the casting and do it when and how it was wanted. The rings and the core of the small size took one flask, those of the large size another flask so that it was possible to carry on the foundry work together, if the patterns were provided. The three plants involved were about two miles apart, which meant some trucking and with lost time. To overcome this handicap all trucking and the cleaning of castings was done at night.

The division of labor had to be considered. There was sufficient skilled help in all departments but from the nature of the parts, there was a great deal of the time when but one man could work on a given piece. This made the problem one of the duration of time each part would be tied up on each operation. The chart in Figure 1 shows how this was plotted after the time for each operation had been estimated and a reasonable allowance made for incidentals. The figures represent the number of days to complete each division (not the number of days' work involved, which was taken up separately as a cost problem).

The form shown by Figure 2 was drawn up and dated. June 4 was the day following the signing of the contract and July 3 and 11 the delivery dates for the small and large sets, respectively.

A study of Figure 1 showed that 12 days would be required to complete the small ring through the boring operation. If this could be crowded into 11 days, the boring could be finished before the 48-inch lathe became unavailable. By working all one night on the patterns, this was done. The neighborly shop would open again on June 24, and the work on the large rings was arranged so as to have them waiting outside the shop door on that morning.

The same operation on the larger mold follows that on the smaller, and it will be noticed that the larger piece is started the day following the completion of the smaller. Thus the lathe or planer hand has his set up all ready and waiting for the second job and takes advantage of continuity of thought and action. The result is that a saving of time and money results.

1918	1 Small Core	2 Small Ring	3 Large Core	4 Large Ring
June 4		Pattern		
5		"		
6		"		
7	Pattern	Cast	Pattern	
8	"	"	"	
10	"	"	"	
11	"	Bore-W	"	
12	"	"	"	
13	Cast	"		
14	"	"	Cast	Pattern
15	"	"	"	"
17	Turn		"	"
18	"	Drill	"	"
* 19	"			Cast
20	Plane	Assemble	Turn	"
21	"	"	"	"
22	"	"	"	"
24	"		"	Bore-W
25			Plane	"
26	Drill		"	"
27			"	"
28	Assemble		"	"
29	"		"	"
July 1	"		Drill	
2	"	Assemble		Drill
3			Assemble	
5			"	Assemble
6			"	"
8			"	"
9			"	"
10				"
11			"	"

* Vacation Period of the Assisting Shop.

FIG. 2. WORKING SCHEDULE

The final assembly had to be made with all three parts of each mold which is shown by the break in columns 2 and 3 under that heading. Along with the work detailed there were numerous bolts, studs and clamps, but as these could be made on tools that were not crowded, they do not appear on either form. With the schedule made up in heroic size and conspicuously posted, it was possible for the superintendent or any man on the job to tell exactly where the work stood, and boosting could be applied if necessary. As a matter of fact, every one concerned took interest in the job and pushed so that the delivery was beaten by a couple of days for each mold.

Time Studies for Rate Setting on Gisholt Boring Mills—V

By Dwight V. Merrick

This is the final installment of Mr. Merrick's series on time studies. The immediately preceding sections have given tables of elementary times for use on Gisholt boring mills. To complete the information it is now necessary to show how the time study data are used in preparing an instruction card. This is done in detail, the piece of work selected being a simple cast-iron bushing.

Mr. Dwight V. Merrick *served a three years' machinist apprenticeship in the shop of the Southwark Foundry & Machine Company, going from there as a journeyman machinist to William Sellers & Company, where he remained for one year. He then spent two years in the engineering course at Drexel Institute. At the completion of this studying he went back to the Southwark Foundry & Machine Company and served as a draftsman for three years, leaving in 1898 to go with Mr. Frederick W. Taylor at the Bethlehem Steel Company. In 1909 he left Bethlehem to go to the Link Belt Engineering Company, where he remained until 1911, devoting himself to time study work. The following two years, 1911-1913, were spent in time study in the shops of the Watertown Arsenal. From 1913 to date* Mr. Merrick *has devoted himself to a consulting practice in time study, giving most of his efforts to the H. H. Franklin Manufacturing Company of Syracuse, New York, and in the manufacture of rifles, rifle ammunition and machine guns.*

AN example in the use of Gisholt boring mill elementary time tables, given in the four preceding issues of INDUSTRIAL MANAGEMENT, for ascertaining the length of time that should be allowed to perform a specific piece of work, or job, will serve to demonstrate most effectively the approved procedure in the use of such time-study data for practical purposes. It will also afford an appropriate opportunity for explaining the approved form of instruction card.

Typical of simple work suited to a boring mill is the machining of a cast-iron bushing 40 inches in diameter, 8 inches face and 34 inches bore. The rough casting would weigh in the neighborhood of 1000 pounds. There would be about half an inch of metal to be removed from each surface of the rough casting, and the work would call for a machine of the 60-inch Gisholt boring mill type. To machine such a piece four major operations would be required, dividing the work into two parts—first, turning the outside diameter and facing one end of the bushing and, second, boring the hole and facing the other end.

STANDARD INSTRUCTION CARD

A standard form of instruction card for recording the instructions and time-study data is shown on page 410 arranged for vertical filing, with an index of the task along the right-hand edge of the card and a tabulated summary of the time allowances, also at right angles to the body of the instructions, in the upper right-hand corner. The main body of the card is divided into a number of vertical columns for convenience in posting the time-study data. The first column is provided simply for the numerical indexing of the consecutive operations, or items, while the second column is reserved for the insertion of the unit times for the necessary tool setting and machine manipulation preceding and immediately following each machining operation. Then comes the wide column for the detailed instructions, followed by three columns for the insertion of strictly technical information concerning the specific machining operations. The last two vertical columns are those in which are recorded the unit times for the various operations, as obtained from the Gisholt boring mill tables. The first is for recording the unit times pertaining to preparation, cleaning machine, removing the work, dismantling and such other acts as are incidental to the job but not of a productive character, and the second column for all unit times involved in actual production.

GROUPING OF THE ITEMS

An analytical study of the detailed instructions for the scheduled items shows that they may be grouped in proper order to form the 12 fundamental operations previously laid down as common to boring mill work, with but one unimportant change made for greater convenience in compiling the instruction card. This variation consists simply in grouping the related fundamental operation combinations of setting tools and manipulating machine to start cuts, and that of manipulating machine at end of cuts and removing tools under one general heading "Manipulate Machine to Set and Start Cut," and placing this combination of four fundamental operations after the operation or operations of machining. The 12 fundamental operations are thus reduced to nine, as follows:

1. Preparing for work.
2. Landing work in machine.
3. Making work run true.
4. Securing work in machine.
5. Machining.
6. Manipulating machine to set and start cut.
7. Loosening chuck jaws.
8. Removing work.
9. Restoring machine to normal condition.

As the job divides itself into two parts, the foregoing sequence of operations occurs twice, but for the acts of preparation and conclusions. The preparation—other than the necessary turning of the chuck jaws on commencing the second part of the work, landing the work within the reverse jaws and closing the jaws on the work—is limited to the first part of the job, while the conclusion—except for the removal of the work on the completion of the first part—occurs on the completion of the second part of the work. A few operations not fundamental to the preparation and production acts, the unit times for which are estimated or derived from experience, are listed as being essential, such as procuring job cards, etc., and cleaning the boring mill table on completion of each part of the job, but the necessity for their insertion is quite apparent.

The first two items, changing the job card, or ticket, and returning to the machine, are essentially preparatory in nature and have to be performed but once, so the unit times involved—their values established by experience and, obviously subject to considerable variation in different shops,—are entered in the preparation time column. The next act, moving the rail from normal, is also preparatory to the actual job and has to be performed but once, so its unit time—obtained from Table 41 of the Gisholt boring mill data—is entered in the preparation time column.

The fourth of the listed items constitutes the real commencement of the actual job, but is also of the nature of preparation and, being necessary but once, its unit time—obtained from the data tables—is entered in the preparation column. The landing of the work on the boring mill table is a fundamental operation for each bushing, so the time entailed is placed in the unit time column, where the unit times for all productively essential operations are posted. Making the piece run true is also a fundamental operation, but as the skillful operator could by suitable marks on the two chuck jaws, which have to be moved to remove the work, avoid the necessity of truing up subsequent pieces of similar dimensions time for the act is required but once, so the necessary unit time is entered in the preparation time column. However, if very accurate turning were required and each piece machined had to be trued, the unit time for the act would be posted in the unit time column.

The balance of the items listed for work on the first part are all fundamental to the work—with the exception of cleaning the boring mill table—so their respective unit times are entered in the unit time column. The various tables referred to in connection with the detailed instructions give, in each case, the source of the respective unit times.

ITEMS FOR THE MACHINING OPERATIONS

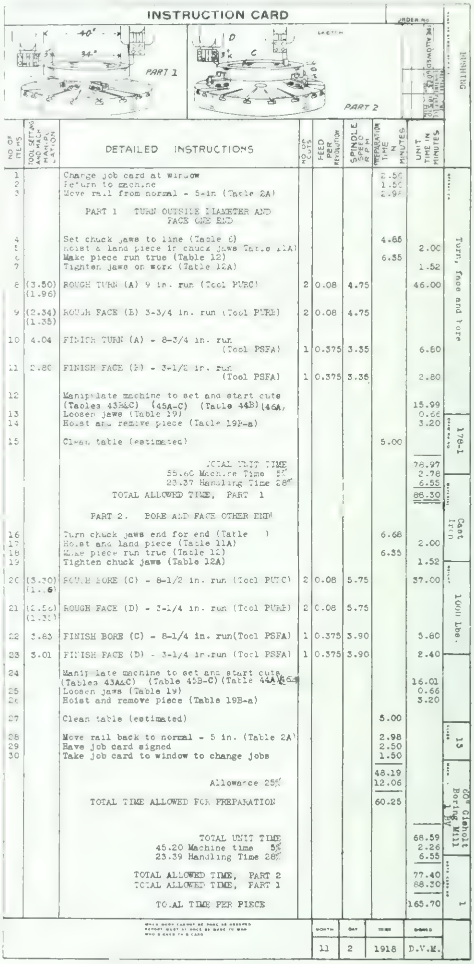
The machining operations, items 8, 9, 10 and 11, require for the determination of their respective unit times information as to the exact machine speeds and feeds to be used. A knowledge of the available power of the machine, the kind of material to be machined—its physical characteristics—and the cutting qualities of the tools to be employed are also involved. The available power is particularly important in the case of roughing cuts.

A standardization of machine tools, as suggested by Mr. Carl G. Barth, in a paper presented before the American Society of Mechanical Engineers in 1916, would greatly simplify the determination of the times required for the machining operations, particularly if use is made of his slide rules for determining the correct speeds and feeds when the diameter of the work, depth of cut and the class of material to be cut is shown.

It is necessary to have calibrated the machine tool for speeds and feeds and tabulated the data for reference before it is possible to predetermine intelligently the time required to perform machining operations in any event, but without standardization and the convenience of all approved aids for making computations the predetermination of machining times is made much more difficult. More time is required for the calculations, errors are more liable to occur and the full value of time study is not realized.

In the case of finishing cuts, the available power of the machine is of small moment, for there is sure to be sufficient power for such cuts, if the power is ample for the heavier roughing cuts. A knowledge has to be acquired, however, of the proper cutting speeds and feeds for the different kinds of tools employed and for the materials machined. Data may be determined by experiment, but to be reliable the investigations must be systematic and comprehensive.

The proper machine speeds and feeds for the various cutting operations, items 8, 9, 10 and 11, once determined, they are entered on the instruction card and the length of runs, or cuts, calculated and recorded as shown. In figuring the run for roughing cuts, an allowance for undue roughness of the casting is advisable, if not necessary, while for finishing cuts it is necessary to allow trial cuts for calipering. Two roughing cuts are allowed and one finishing cut on each surface of the bushing, so the calculations for length of run are slightly involved. In the case of the two roughing cuts over the face of the bushing, one is necessary over the full face of the rough casting—9 inches plus any allowance for roughness—and the second over but about 8¾ inches, as before the second cut is started the face of the casting has been reduced by the thickness of the first rough facing cut. The mean run of the rough turning tool is then approximately 8 inches.


ORDER NO
SKETCH
40"
34"
3"
PART 1
D
C
3
PART 2

INSTRUCTION CARD

NO OF ITEMS	TOOL SETTING AND MACH. MANIPULATION	DETAILED INSTRUCTIONS	NO OF CUTS	FEED PER REVOLUTION	SPINDLE SPEED R P M	PREPARATION TIME IN MINUTES	UNIT TIME IN MINUTES
1		Change job card at window				2.50	
2		Return to machine				1.50	
3		Move rail from normal - 5-in (Table 2A)				2.98	
		PART 1 TURN OUTSIDE DIAMETER AND FACE ONE END					
4		Set chuck jaws to line (Table 6)				4.85	
5		Hoist & land piece in chuck jaws Table 11A)					2.00
6		Make piece run true (Table 12)				6.35	
7		Tighten jaws on work (Table 12A)					1.52
8	(3.50) (1.96)	ROUGH TURN (A) 9 in. run (Tool PURC)	2	0.08	4.75		46.00
9	(2.34) (1.35)	ROUGH FACE (B) 3-3/4 in. run (Tool PURE)	2	0.08	4.75		
10	4.04	FINISH TURN (A) - 8-3/4 in. run (Tool PSFA)	1	0.375	3.35		6.80
11	2.80	FINISH FACE (B) - 3-1/2 in. run (Tool PSFA)	1	0.375	3.35		2.80
12		Manipulate machine to set and start cuts (Tables 43B&C) (45A-C) (Table 44B) (46A,					15.99
13		Loosen jaws (Table 19)					0.66
14		Hoist and remove piece (Table 19B-a)					3.20
15		Clean table (estimated)				5.00	
		TOTAL UNIT TIME					78.97
		55.60 Machine Time 5%					2.78
		23.37 Handling Time 28%					6.55
		TOTAL ALLOWED TIME, PART 1					88.30
		PART 2. BORE AND FACE OTHER END					
16		Turn chuck jaws end for end (Table)				6.68	
17		Hoist and land piece (Table 11A)					2.00
18		Make piece run true (Table 12)				6.35	
19		Tighten chuck jaws (Table 12A)					1.52
20	(3.30) (1..6)	ROUGH BORE (C) - 8-1/2 in. run (Tool PURC)	2	0.08	5.75		37.00
21	(2.56) (1.35)	ROUGH FACE (D) - 3-1/4 in. run (Tool PURE)	2	0.08	5.75		
22	3.83	FINISH BORE (C) - 8-1/4 in. run(Tool PSFA)	1	0.375	3.90		5.80
23	3.01	FINISH FACE (D) - 3-1/4 in.run (Tool PSFA)	1	0.375	3.90		2.40
24		Manipulate machine to set and start cuts (Tables 43A&C) (Table 45B-C)(Table 44A)(46					16.01
25		Loosen jaws (Table 19)					0.66
26		Hoist and remove piece (Table 19B-a)					3.20
27		Clean table (estimated)				5.00	
28		Move rail back to normal - 5 in. (Table 2A)				2.98	
29		Have job card signed				2.50	
30		Take job card to window to change jobs				1.50	
						48.19	
		Allowance 25%				12.06	
		TOTAL TIME ALLOWED FOR PREPARATION				60.25	
		TOTAL UNIT TIME					68.59
		45.20 Machine time 5%					2.26
		23.39 Handling Time 28%					6.55
		TOTAL ALLOWED TIME, PART 2					77.40
		TOTAL ALLOWED TIME, PART 1					88.30
		TOTAL TIME PER PIECE					165.70

BUSHING
Turn, face and bore
178-1
Cast Iron
1000 Lbs.
13
60" Gisholt Boring Mill
1 BY
1

MONTH	DAY	YEAR	SIGNED
11	2	1918	D.V.M.

INSTRUCTION CARD FOR GISHOLT BORING MILL

In calculating the mean run of the rough facing tool, even more of an approximation is sufficiently accurate for practical purposes. The first rough facing cut is commenced after the first roughing cut on the diameter of the casting has been started—the thickness of the ring being less than the face of the casting—so its run is less than 4 inches, the thickness of the rough ring. Simi-

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[1] INDUSTRIAL MANAGEMENT for July, 1918, page 30

larly, the second rough facing cut is commenced after the start of the second roughing turning cut, so its run is not much more than 3½ inches. The mean length of run for the rough facing cuts may be taken as 3¾ inches, however, for all practical purposes. In the case of the finishing cuts, a ¼-inch trial run is added to the actual face of the partly machined bushing, making the finish cut run 8¾ inches, but no trial run is necessary for the facing tool, for any slight error can be corrected when facing the other end of the bushing. The lengths of the respective mean runs are entered on the instruction card, with the symbol of the particular tool to use in each case. With the length of runs determined and the correct feeds and speeds known, the unit times for the actual cutting operations are calculated and entered in the column of unit times.

The time values inserted in the column headed "Tool Setting and Machine Manipulation" are the unit times for such setting of the tool, manipulating the machine to start, and at end of cut and removing the tool, as may be required for the respective cuts—the times obtained from the data tables. For the roughing cuts, two such entries are made as there are two cuts to be taken, but for the single finishing cuts one entry is sufficient. These tool setting and machine manipulating times are then added and their sum entered in the unit time column as the time for item 12, "Manipulate Machine to Set and Start Cut."

The unit times for items 13 and 14 are obtained directly from the data tables and entered in the unit time column, for they are fundamental to the work. Item 15, cleaning the boring mill table, is a necessary but not essential act in the work. It is customary to make a time allowance for such cleaning but once for each part of the job, whether the job calls for one bushing or several as the operator can clean off his boring mill table without interfering with the steady progress of his work, if he has more than one bushing to machine. He could complete the first part of the work on all bushings before commencing the second part. Time for cleaning table is, therefore, inserted in the preparation time column.

SECOND PART OF THE WORK

The unit times for the various items constituting the second part of the work are obtained in a very similar manner. The acts of preparation and conclusion of task differ, but the instructions for the various acts as given on the instruction card, with the reference as to the source from which the unit times are obtained, should make the procedure quite apparent.

The column headed "Preparation Time" is totaled and a flat allowance of 25 per cent. added to give the time allowed for preparation. The column of unit times entailed in the actual conduct of the work is also summed up for each of the two parts of the job. To the machine time included in the summations is added an allowance of 5 per cent. and to the handling time a percentage which is dependent upon its (handling time) proportion of the total time required for the job. This percentage is obtained from the allowance curves.[2]

It will be noted that the handling time allowance for both parts of the job is the same, so that the unit time column could be summed up as a whole and the allowance added but once, instead of totaling the unit times for each part of the work and adding the same per cent. of allowance to each of the partial totals. The total result would be the same, but the division is regularly made, as if the job called for several bushings it would be necessary to know the task time for whichever part of the work the operator was working on.

Reference to the allowance curves shows that for any job in which the time required to complete one piece is more than a quarter of an hour the percentage allowance for handling time, irrespective of what proportion it may be of the total time required for the job, lies between 23 and 32 per cent. The longer the work takes, per piece, the nearer the proper allowance comes to a mean value of 28 per cent. provided the time consumed in machining constitutes the major part of the total time consumed for the job. In fact, it is customary to make a flat allowance of 28 per cent. for handling time on all machine-tool jobs taking 15 minutes or so to complete. In a shop where all jobs take considerable time, it may even be more convenient to increase the unit times recorded in the time tables by a fixed percentage and thereby avoid the necessity of adding a handling time allowance on the instruction card. If the preparation time constitutes but a small proportion of the total time for a job that takes an hour or longer to perform, the handling time percentage allowance may be reduced to 25 per cent. or the same as the percentage added to the preparation time, so that all unit times may be increased by such proportion before entry on the instruction card.

Labor After the War--A Questionnaire

READERS of INDUSTRIAL MANAGEMENT will remember the report presented early this year on "Women in Industry" based on the questionnaire sent to about 1000 manufacturers by C. E. Knoeppel & Co., Inc. The result from that effort was so satisfactory that another question has now been taken up for investigation.

The topic is "Labor After the War," and is one that everybody is considering seriously especially in the light of recent events.

Over 5000 manufacturers are being addressed with the request that they reply to the following questions:

1. Will there be a great labor party after the war?
2. Will immigration be much reduced, stop altogether or a tide of emigration begin?
3. What effect will women in industry have on labor?
4. What will be the tendency along lines of industrial education?
5. In what manner will the factory system be modified?
6. What part will labor play in the matter of hours, working conditions and income from work done?
7. What about the health of the worker, pensions and insurances?
8. What will be labor's attitude regarding the efficiency movement?
9. Will there be more or less coöperation between capital and labor?
10. Will there be strikes or industrial arbitration?
11. What will be labor's attitude towards quantity production?
12. Will we have to go through an industrial war to win industrial democracy, the same as we have had to go through a military war to win political democracy?

The replies will be analyzed, combined and presented in composite form with the hope that they will serve a worthy purpose in connection with the decisions that must be made by the Government. All of this work will be done at no cost to either the manufacturers or to the Government.

Will you coöperate?

Please answer the questions sending replies to: C. E. Knoeppel & Co., Inc., 101 Park Avenue, New York City.

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[2] INDUSTRIAL MANAGEMENT, June, 1918, page 442.

Employment Department Routine of the Curtiss Aeroplane & Motor Corp.

By Charles E. Fouhy

The work of an employment department handling labor for a firm making war material involves a number of responsibilities not found in the ordinary industrial plant. To expedite such work the department routine must be crystallized and each step must be preplanned. One step in accomplishing this result is to develop an adequate series of forms. Objection is frequently made to articles which show the actual arrangement and setup of forms and blanks, but when these are presented as a whole, showing how each one is used in the department routine, many of them become helpful suggestions. This article shows the routine and forms of the employment department of a large firm.

Mr. Charles E. Fouhy *has had 17 years of experience strictly on employment work. He was in charge of the Labor Bureau of the Boston branch of the National Metal Trades Association; installed and operated the employment department of the Employers' Association of Massachusetts; installed and operated the employment department of Lever Bros. Company, Limited, of Cambridge, Massachusetts; was assistant to the Eastern Representative of the National Founders' Association dealing with labor methods; and during the past one and a half years has been employment and employees' service manager for the Curtiss Aeroplane & Motor Corporation, Buffalo, New York.*

WHEN a requisition is placed in the hands of the purchasing department, the department placing this requisition usually states the kind of material wanted and gives a detailed description of the quality and quantity desired. The purchasing department immediately proceeds to procure the article required and of its own initiative secures the material and places it at the disposal of the department head without consulting him.

This is exactly the procedure followed in our employment department. A department head makes requisition upon us for labor, and it is our function to secure the labor required and send it directly to the department. We do not have the foremen or superintendent pass upon the employees to be hired, neither do the foremen or superintendent set the rates. When a man leaves the employment department he knows exactly the class of work he is to do and the rate of wages is set at the same time.

We believe that the old idea of the employment interviewer sending a man to the factory for the foreman's final approval is nothing more or less than a refusal on the part of the employment department to assume full responsibility for hiring the man; in other words, the employment manager desires an alibi by passing responsibility on to the foreman if the man employed does not measure up to the job. It has often been said that the foremen resent the idea of the employment department hiring men for them without being given an opportunity of passing upon the man's qualifications. The foreman's particular work is getting out production, and his work should be so confiing and important that he should have no leisure moments to interview or select help.

In this respect our employment department assumes full responsibility for every man who is employed, and we do not find that there is any opposition on the part of the shop executives toward the men who are hired. In fact we have found that we have the utmost coöperation from our foremen and superintendents, and that there is no desire on their part to question the rights of this department in hiring outright the men assigned to them.

If an employment department is worthy of the name it certainly is entitled to full authority to select employees for every department of the plant.

The employment department, as will be noted from the floor plan, Figure 1, is laid out with the idea of the progressive handling of the applicants calling at the office for work. The applicant on entering the employment department is handed a preliminary interview application for employment, Figure 2, and the information clerk directs him to a stand-up desk where he makes out his application. The application is then scrutinized by an attendant, who directs the applicant to the particular interview room where this class of help is employed.

We have three separate interviewing rooms as follows: For metal workers; wood workers; office and clerical help, and female employees for the factory.

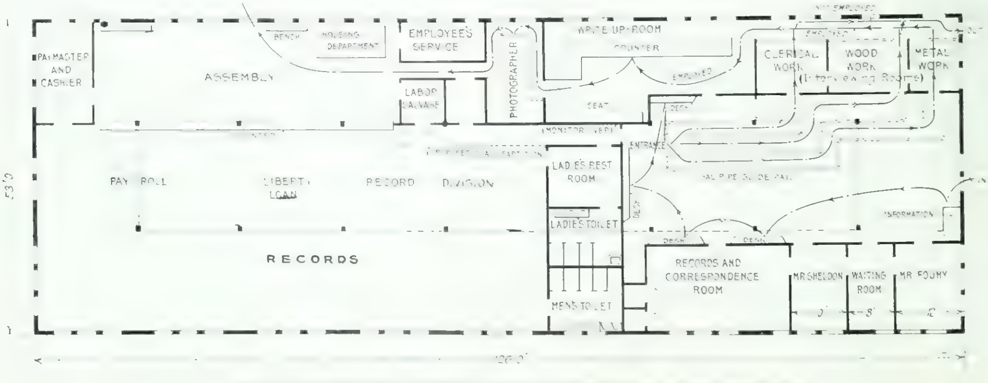
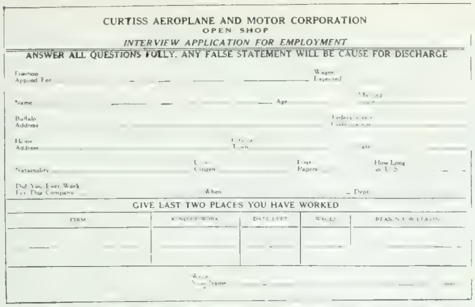


FIG. 1. PLAN OF EMPLOYMENT BUILDING, CURTISS AEROPLANE & MOTOR CORPORATION



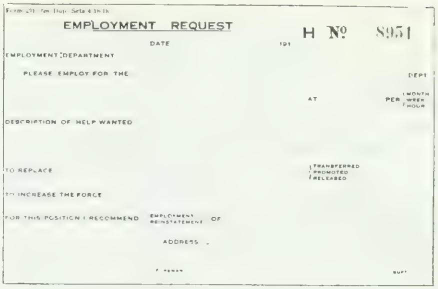
CURTISS AEROPLANE AND MOTOR CORPORATION
OPEN SHOP
INTERVIEW APPLICATION FOR EMPLOYMENT
ANSWER ALL QUESTIONS FULLY. ANY FALSE STATEMENT WILL BE CAUSE FOR DISCHARGE

Position Applied For
Wages Expected
Name
Age
Buffalo Address
Home Address
Nationality
Citizen
First Papers
How Long in U. S.
Did You Ever Work For This Company
When
Dept

GIVE LAST TWO PLACES YOU HAVE WORKED

FIRM	KIND OF WORK	DATE LEFT	WAGES	REASON FOR LEAVING

FIG. 2. PRELIMINARY APPLICATION FOR EMPLOYMENT



EMPLOYMENT REQUEST
H № 8951
DATE 191
EMPLOYMENT DEPARTMENT
PLEASE EMPLOY FOR THE DEPT
AT PER MONTH WEEK HOUR
DESCRIPTION OF HELP WANTED
TO REPLACE TRANSFERRED PROMOTED RELEASED
TO INCREASE THE FORCE
FOR THIS POSITION I RECOMMEND EMPLOYMENT REINSTATEMENT OF
ADDRESS
FOREMAN
SUPT

FIG. 3. FORM USED FOR EMPLOYMENT REQUEST

In the metal workers interviewing room we handle the following: Machinists, all classes; tool, die, jig and fixture makers; metal assembly department employees; wire workers; maintenance men, including machinists, steamfitters, electricians, bricklayers, plumbers, etc.

In the wood workers interviewing room the following are handled: Carpenters; cabinet makers; mill hands—bench and machine; wood assemblymen; shipping department help; painters, etc.

In the office and clerical interviewing room the following are handled: Accountants; auditors; bookkeepers; invoice clerks; stenographers and typists, male and female; office clerks, male and female; errand boys; errand girls.

Factory girls are also hired in this third office and are sent to the training department for intensive training for the particular class of work for which they are best adapted. When they are hired they are not assigned to any special work, but are sent direct to the training department, and it is the function of this department to ascertain the class of work the girl likes best and help her to make a success of it. When she has learned the work sufficiently well to handle regular production, she is transferred to a production department with an increase in rate.

Our experience has been that it is impossible to handle a large number of men and women without some indication of their previous experience and class of work desired. Our preliminary application blank gives us the position applied for, name, Buffalo address, home address, nationality, age, wages expected, married or single, United States citizen or not, draft classification and the last two places worked. It is necessary to ask all applicants who apply for work certain leading questions as to their last places of employment, how long employed, wages received, reason for leaving and certain other information which requires time. By having a preliminary application we can tell at a glance the essential information required and can, with a few direct questions, ascertain whether or not he is a man we desire.

If we decide to employ him we refer to our employment request, Figure 3. This employment request is issued by the department desiring additional help, is serially numbered and is made out in duplicate. The original copy is retained by the department issuing the request and the duplicate is sent to the employment department. On this form we are able to determine the class of help required with the specific information about the job requirements.

If additional information is required regarding the specific nature of the work we refer to our job analysis, which gives in full detail the department, machine equipment, kind of help, job requirements and work performed. See Figure 4. On the reverse of this card space is provided to enter names, addresses and dates of reporting of all persons hired to fill this request.

On the reverse side of the preliminary interview application, Figure 2, we note who interviewed the man, class of work hired for, time to report, date to start, rate, department, name of foreman and requisition number. If we do not hire the man we write in the reason

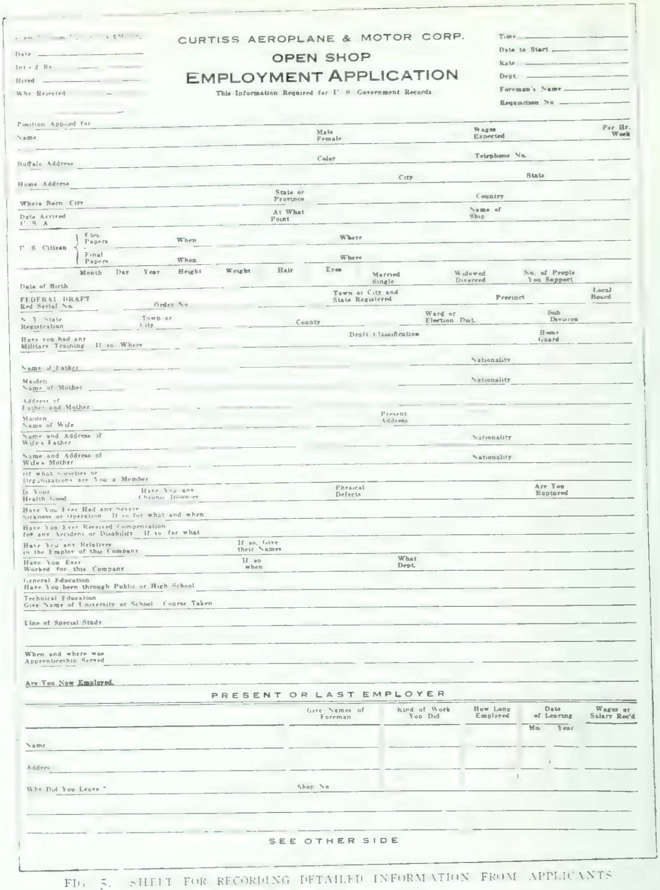
Dept.	*Machine Equipment*	*Kind of Help*	*Job Requirements*	*Work Performed*
Sheet Metal	2 Speed Lathes (Blount) 2 Power Riveters (Grant Mfg. Co.) 30 Power Filing machines (Prentiss)	Bench Machinists	First-class experienced machinists. Able to read blue prints, lay out work and do bending work	Do bending on bending and forming blocks, work on drill presses, lathes, riveters and punch presses
		Machine Filers	Inexperienced girls under supervision of forelady	File sheet metal
	Electric Spot Welders (Federal)	Spot Welders	Inexperienced girls	Spot weld clips, housings, hingings, straps, etc.
	54 Oxy-acetylene Welders (Presto-lite)	Welding Instructors	First-class experienced oxy-acetylene welders in light tube work	Instruct and supervise
		Welders	Inexperienced girls	Acetylene weld supports shaft assemblies, housings, etc., and some parts which have already been welded in order to make a stronger and cleaner job
	46 Drill Presses (Chas. G. Allen)	Drill Press Operators	Inexperienced girls	Drill work on sheet metal
		Hand Filers	Experienced filers in filing flat metal to line	File burrs on flat metal
	16 Furnace Brazers	Furnace Brazers	Experienced furnace brazers, preferably men who have had experience on bicycle brazing	Braze flat metal

FIG. 4. JOB ANALYSIS SHEET

and the card is filed, if a desirable applicant, for future reference. The men who are not hired are directed to go out a door to the right and thence to the street. Applicants who are employed are directed to go to the left, follow along a passageway until they come to the write-up desk. At this write-up desk the clerk makes out a permanent application, Figure 5. This application covers certain information that we are requested to furnish the Government from time to time, and has proved very valuable in tracing undesirable and questionable characters.

The information on the reverse side of the form of Figure 2 is written in at the upper left- and right-hand corners of the form, Figure 5, and put on the notice form, Figure 6, which is made out in triplicate. We also assign at this time a folder for each employee (see Figure 7), which contains space for the entire record of the employee while in our employ. All papers pertaining to the individual are also placed in this folder. The folder card, not shown here, numbered the same as the folder, is then issued, and the applicant is handed a slip, form Figure 8, which is presented to the photographer.

We are now using an individual gate pass, Figure 9, which bears the plant letter, designation as to whether day or night or hourly work, department number and folder number, *i. e.*, the symbol, G-D-5, indicates that the worker is an employee of the North Elmwood Plant, is a day worker and working in the metal division, which is No. 5. Pending the delivery of his photographic pass a temporary gate pass is issued.



[illegible]
Date
Int'd By
Hired
Why Rejected

CURTISS AEROPLANE & MOTOR CORP.
OPEN SHOP
EMPLOYMENT APPLICATION
This Information Required for U. S. Government Records

Time
Date to Start
Rate
Dept.
Foreman's Name
Requisition No

Position Applied for
Name — Male Female — Wages Expected — Per Hr. Week
Buffalo Address — Color — Telephone No.
Home Address — City — State
Where Born City — State or Province — Country
Date Arrived U. S. A. — At What Point — Name of Ship
U. S. Citizen { First Papers — When — Where
Final Papers — When — Where
Date of Birth — Month — Day — Year — Height — Weight — Hair — Eyes — Married Single — Widowed Divorced — No. of People You Support
FEDERAL DRAFT Red Serial No. — Order No. — Town or City and State Registered — Precinct — Local Board
N. Y. State Registration — Town or City — County — Ward or Election Dist. — Sub Division
Have you had any Military Training If so Where — Draft Classification — Home Guard
Name of Father — Nationality
Maiden Name of Mother — Nationality
Address of Father and Mother
Maiden Name of Wife — Present Address
Name and Address of Wife's Father — Nationality
Name and Address of Wife's Mother — Nationality
Of what Societies or Organizations are You a Member
Is Your Health Good — Have You any Chronic Diseases — Physical Defects — Are You Ruptured
Have You Ever Had any Severe Sickness or Operation If so for what and when
Have You Ever Received Compensation for any Accident or Disability If so for what
Have You any Relatives in the Employ of this Company — If so, Give their Names
Have You Ever Worked for this Company — If so when — What Dept.
General Education Have You been through Public or High School
Technical Education Give Name of University or School Course Taken
Line of Special Study
When and where was Apprenticeship Served
Are You Now Employed.

PRESENT OR LAST EMPLOYER

	Give Names of Foreman	Kind of Work You Did	How Long Employed	Date of Leaving Mo.	Date of Leaving Year	Wages or Salary Rec'd
Name						
Address						

Why Did You Leave? — Shop No.

SEE OTHER SIDE

FIG. 5. SHEET FOR RECORDING DETAILED INFORMATION FROM APPLICANTS

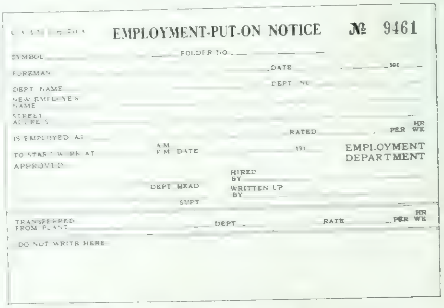
Preliminary application, together with the regular employment application and the white and yellow copies of the put-on slip are then inserted in the folder and the blue copy retained in the employment department for record. The folder is then sent to our record division—details of its operation will be explained later.

After the applicant has had his photograph taken he is instructed to report to the employees' record division the following morning and present folder card, Figure 8.

When the employees' record division receives the folder, Figure 7, the first step is to assign a clock number. This is then passed on to the addressograph operator, who prepares an addressograph plate bearing the man's name, rate, folder number and clock number. This information is then stamped on all his credentials, consisting of a weekly time sheet, Figure 10, white and yellow copies of the put-on notice, Figure 6, and a daily clock card, which is described as follows:

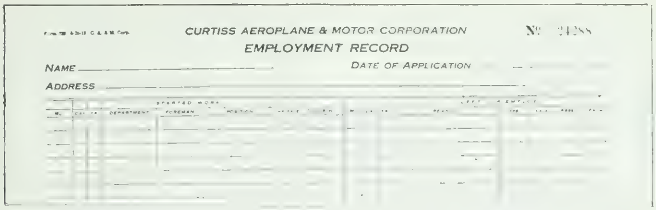
The new employee for the first week will have the form of Figure 11, which is green in color and indicates to the timekeeper that a new employee is in that department. After he has been with us a week he has a form identical with Figure 11 except that it is white in color. If he is to work on the night shift he is given the form of Figure 12, which is a green card with double red lines across the face to show that he is a new man on the night shift. After his first week on the night shift, he is given the form of Figure 13, which is yellow in color. A small 3 x 5-inch white card is also stamped up at this time, giving the name, clock number and department, from which we make out our daily report of the activities of the employment department.

When a man reports for work the following morning he is handed the yellow copy of the put-on notice, the form of Figure 6, daily time card, a weekly time sheet and the small 3 x 5 white card. He is then directed to the delivery clerk of the employment department, where



[illegible]
EMPLOYMENT-PUT-ON NOTICE № 9461
SYMBOL — FOLDER NO.
FOREMAN — DATE — 191
DEPT. NAME — DEPT. NO.
NEW EMPLOYEE'S NAME
STREET ADDRESS
IS EMPLOYED AS — RATED — PER HR WK
TO START WORK AT — A.M. P.M. DATE — 191
EMPLOYMENT DEPARTMENT
APPROVED
DEPT. HEAD
SUPT.
HIRED BY
WRITTEN UP BY
TRANSFERRED FROM PLANT — DEPT. — RATE — PER HR WK
DO NOT WRITE HERE

FIG. 6. PUT-ON NOTICE USED IN FACTORY



CURTISS AEROPLANE & MOTOR CORPORATION

EMPLOYMENT RECORD

NAME

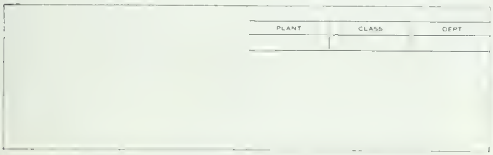
DATE OF APPLICATION

ADDRESS

FIG. 7. UPPER PORTION OF MANILA ENVELOPE USED AS FOLDER FOR EMPLOYEES

his white card is taken up and he is sent by a messenger to the department to which he has been assigned. A "Plant Protection" letter from Mr. J. E. Kepperley, Vice-President and General Manager, is handed him at this time.

The foreman upon receiving the man in his department, immediately takes up the yellow copy of the put-on notice, Figure 6, which he retains as his permanent record. Later in the day the white form of the put-on notice, Figure 6, is taken to the foreman and the superintendent for signature. This is then returned to the payroll department as their authority for entering the name on the payroll and is filed in the folder as a permanent record.



PLANT	CLASS	DEPT

FIG. 8. EMPLOYEE'S SLIP FOR PHOTOGRAPHER

Every morning our service man receives a report from the foreman and timekeeping department of the employees who have not reported for work. The service man immediately proceeds to call at the home of everyone of these employes and ascertain the real reason for the absence.

In view of the fact that we are engaged on 100 per cent. war work it is necessary that every employee give 100 per cent. of his working time. It is our purpose to imbue our workers thoroughly with the importance of being on their jobs six days a week, and our experience has proven the value of our service men in following up absentees. We have found that it has served a wonderful purpose in reducing our absenteeism to a minimum. It gives us a chance to have a heart to heart talk with workers who are in the habit of laying off a day or two. It also is a check upon labor turnover, and if our employees are dissatisfied we can adjust the trouble and get them back on the job without any unnecessary loss of time.

If, however, an employee is absent three days in succession without permission, an automatic removal, the form Figure 14, is placed in the clock rack and the employee must come to the employment department before he can be reinstated. At this time we determine whether or not the circumstances as explained by him warrant his reinstatement and the matter is then taken up and he is handled accordingly.

When a man has proven worthy of a change of rate, a request for a change of rate card is made out by the foreman and sent to the employees' record division, the foreman retaining the stub. Upon receipt of this request the employees' record division issues a change of rate card, which gives folder number, age, name, clock number, occupation, department and previous rate changes and the reason for the new rate change. This must be approved by the department head or general foreman, superintendent or plant manager. When this has been properly signed it is sent back to the employees' record division. The addressograph plate is changed to bear the new rate and is passed on to the payroll department for notation.

When an employee has a pay shortage claim he goes to his timekeeper, makes known his complaint and the timekeeper issues a pay shortage claim, Figure 15. Four copies of this form are made out. One copy is retained by the timekeeper, one goes to the workman, one to the foreman and the original copy is sent to the payroll department for investigation. If it is found that the claim is allowed the payroll department sends the pay shortage claim back to the timekeeper, who notifies the employee and he surrenders his copy of the pay shortage claim, receives the original copy and is directed to the cashier for payment.

In transferring employees from one department to another we use an inter-department transfer notice, Figure 16, the routine being as follows::

The foreman will issue to the employee an inter-department transfer notice and send him to be properly cleared by the tool or uniform crib and instructs the em-

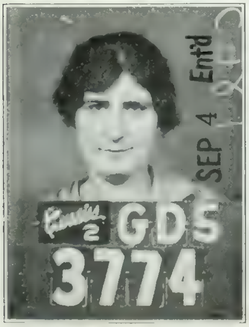
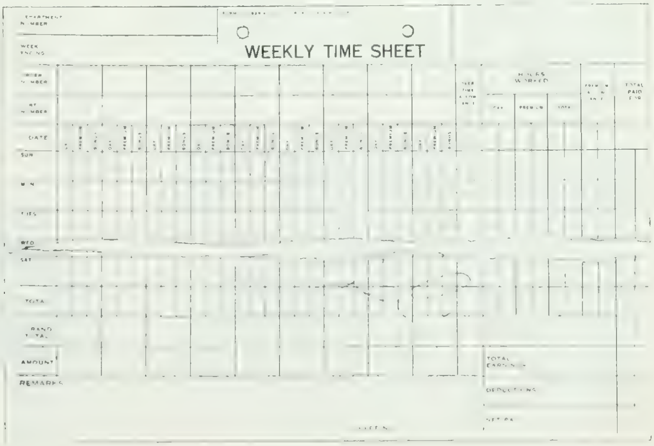


FIG. 9. INDIVIDUAL GATE PASS

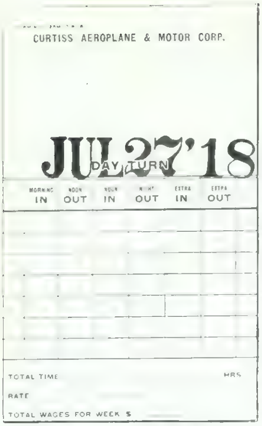


WEEKLY TIME SHEET

AMOUNT

REMARKS

FIG. 10. WEEKLY TIME SHEET FOR OFFICE FILE



CURTISS AEROPLANE & MOTOR CORP.

JUL 27 '18

DAY TURN

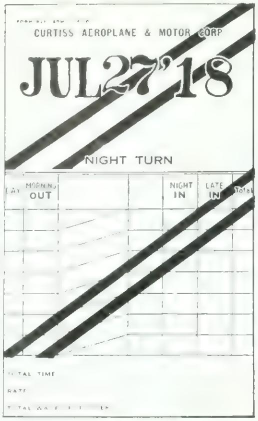
MORNING IN	NOON OUT	NOON IN	NIGHT OUT	EXTRA IN	EXTRA OUT

TOTAL TIME HRS

RATE

TOTAL WAGES FOR WEEK $

FIG. 11. GREEN CARD



CURTISS AEROPLANE & MOTOR CORP

JUL 27 '18

NIGHT TURN

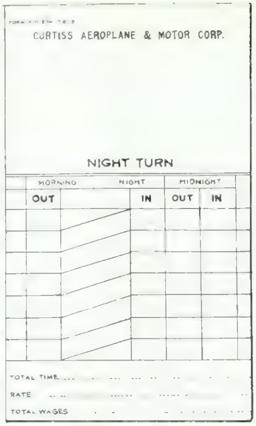
DAY	MORNING OUT			NIGHT IN	LATE IN	Total

TOTAL TIME

RATE

TOTAL WAGES FOR WEEK

FIG. 12. GREEN CARD



CURTISS AEROPLANE & MOTOR CORP.

NIGHT TURN

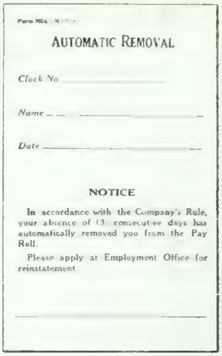
	MORNING OUT		NIGHT IN	MIDNIGHT OUT	MIDNIGHT IN	

TOTAL TIME

RATE

TOTAL WAGES

FIG. 13 YELLOW CARD



Form 700A

AUTOMATIC REMOVAL

Clock No

Name

Date

NOTICE

In accordance with the Company's Rule, your absence of 13 consecutive days has automatically removed you from the Pay Roll.

Please apply at Employment Office for reinstatement

FIG. 14 RED CARD REMOVAL

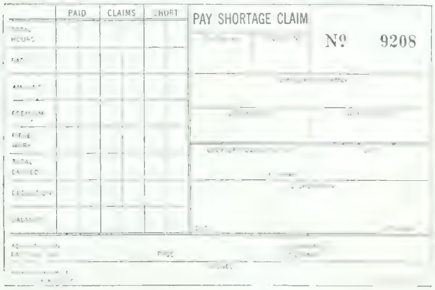
ployee to report to the foreman of the new department who approves the transfer and sends the employee to the employment department with his pass, time card and transfer notice. If possible the employment department will approve the transfer notice and apply the employee on some requisition asking for his or her grade of skill. The employee will then surrender time card, pass and transfer, be re-classified, re-photographed and receive new credentials from the records division.

Transfers take effect only at the close of, beginning of, or at noon on any working day.

When we are transferring employees from one factory to another we use an inter-factory transfer notice, Figure 17, made out in duplicate. The duplicate copy is taken up by the employees' service division of the plant from which the man is transferred, and the original copy is sent with the employee to the plant to which he is assigned. The form of Figure 17 must bear a tool crib stamp the same as a removal notice, and the man must be entirely cleared of tools before leaving the plant. The employee must also leave his time sheet and time card with the duplicate of Figure 17 at the plant from which he is transferred.

LABOR SALVAGE

All employees, who for any reason are leaving the employ of the company, must pass through the employees' service division. This is to interrogate all employees to ascertain the real reason for their leaving. However, if for any reason we find that they are dissatisfied with their present position, either on account of working conditions, rate or other personal reasons, we immediately take up the case for adjustment. In this way we have been very successful in adjusting imaginary and sometimes real complaints, whereas we would have otherwise lost the employee. We call this our labor salvage department of the employees' service division. And why not labor salvage? We go to considerable bother and expense to salvage material spoiled in the production departments, whereas until recently we have made no effort to reclaim one of the most important links in any line of manufacturing endeavor, "man-power."

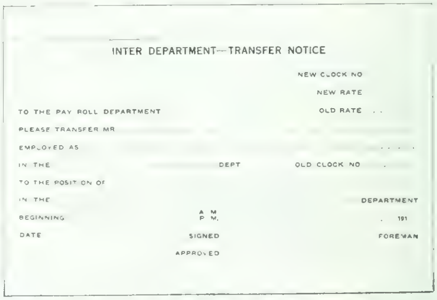


	PAID	CLAIMS	SHORT
HOURS			
RATE			
AMOUNT			
PREMIUM			
PIECE WORK			
TOTAL EARNED			
DEDUCTION			
BALANCE			

PAY SHORTAGE CLAIM

№ 9208

FIG. 15. PAY SHORTAGE CLAIM CARD



INTER DEPARTMENT—TRANSFER NOTICE

NEW CLOCK NO

NEW RATE

TO THE PAY ROLL DEPARTMENT OLD RATE

PLEASE TRANSFER MR

EMPLOYED AS

IN THE DEPT OLD CLOCK NO

TO THE POSITION OF

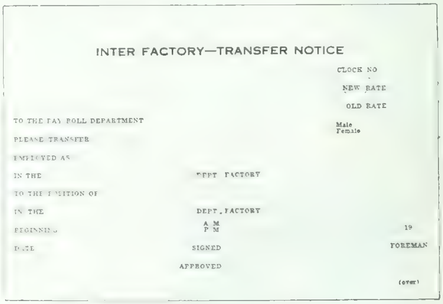
IN THE DEPARTMENT

BEGINNING A.M. P.M. 191

DATE SIGNED FOREMAN

APPROVED

FIG. 16. TRANSFER OF EMPLOYEE TO ANOTHER DEPARTMENT



INTER FACTORY—TRANSFER NOTICE

CLOCK NO

NEW RATE

OLD RATE

TO THE PAY ROLL DEPARTMENT Male Female

PLEASE TRANSFER

EMPLOYED AS

IN THE DEPT FACTORY

TO THE POSITION OF

IN THE DEPT. FACTORY

BEGINNING A.M. P.M. 19

DATE SIGNED FOREMAN

APPROVED

(over)

FIG. 17. FACTORY TRANSFER NOTICE

It is usually a very easy matter to handle workmen if they have confidence in your sincerity.

Electrically Heated Industrial Appliances and Devices

By George J. Kirkgasser

The utilization of electricity for heating appliances, devices and tools in industrial plants seems to have started on a period of as widespread growth as took place a few years ago in connection with the application of electricity for lighting and power. This article briefly outlines the most important applications classified for 18 different industries in a series of 32 illustrations and shows many of the simpler devices. Many a helpful suggestion may be discovered in these for the solution of some perplexing manufacturing problems.

Mr. George J. Kirkgasser *from 1907 to 1909 was engaged in electrical construction work, then for two years was electrical and fire hazard inspector for industrial plants in the western part of the State of New York and assistant engineer for the Underwriters Laboratories, Inc., for that section. In 1910 he became connected with the Cutler-Hammer Manufacturing Company of Milwaukee, handling the relationships of that firm with engineering publications and the technical societies. In 1913-14 he wrote and published "Electric Lighting and Motor Wiring" and has been a frequent contributor to the technical press. He is a graduate of the University of Syracuse in the Electrical Engineering Course.*

HEAT in some form is used in practically every industry, and the industrial applications of electric heat and heating appliances have been extended to almost every kind of factory. In this respect electricity for heating purposes seems to be undergoing the same growth as electricity for lighting and power. Advantages peculiar to the ways by which electrically generated heat can be used in industrial applications and processes have led to the rapid development of electric heating equipment.

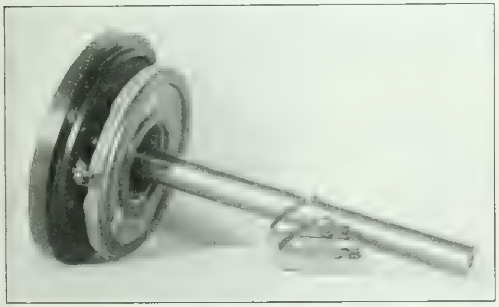


FIG. 1. DISC WITH HEATER UNIT FOR MAKING PAPER CARTONS

Safety, reduced fire hazard, ease of control and flexibility of application are the chief advantages. The heat may be employed in a very limited space or over a larger area, at a low or high temperature. Electric heat gives off no gases and so can be used in any atmosphere, which is not true of heat produced from the combustion of coal, wood, gas, oil or other fuel.

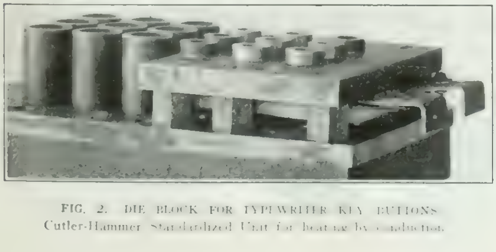


FIG. 2. DIE BLOCK FOR TYPEWRITER KEY BUTTONS
Cutler-Hammer Standardized Unit for heating by conduction

In drying and baking, as an example, the temperature can be held just below 212 degrees Fahrenheit, so that moisture is not converted into steam. The advantage of this is that water vapor does not have to be dealt with and no additional ventilation of the oven is required. In the treatment of steel, scale-forming is eliminated together with other effects that waste material. In the heating of liquids and melting metals the flexibility of electric resistance materials permits of shaping and imbedding the heater units to bring them in most intimate contact with the substance to receive the heat and thus produce efficient and uniform results.

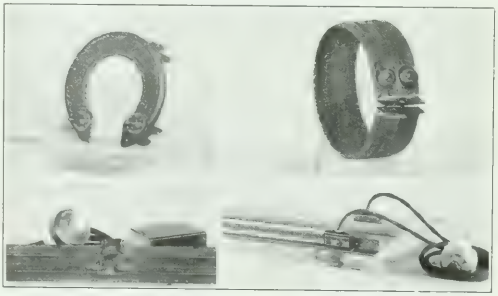


FIG. 3. ABOVE—RUBBER TUBE HEATER FIG. 4. ABOVE—DIE FOR PAPER CUPS, ETC.

FIG. 5. BELOW—HEATER PLATE FOR SEALING MACHINES FIG. 6. BELOW—DRYER UNIT FOR PAPER CARTON MACHINE

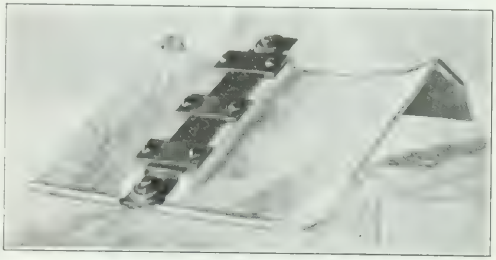


FIG. 7. HEATER UNIT FOR SEALING PAPER WRAPPERS ON BREAD
Attached to under side of an aluminum casting

FIG. 8. [illegible] STRIP HEATER

In many heating operations the cost of heat energy is only a small part of the total cost of a product and for this reason methods to make savings in these operations have been overlooked.

Applying electricity for heating purposes brings the matter of methods employed into the limelight and inefficiencies are exposed. Sometimes cycles of operations are rearranged, a reduced amount of manual labor is needed in nine cases out of ten, and there are fewer cases of imperfect products.

As another result of easy control of electricity the temperature can be maintained or varied automatically or manually to produce a more uniform product. With operations where automatic control of current and temperature are used the human element is eliminated.

The applications of various appliances which have been more or less standardized do not offer a serious problem since these devices perform somewhat similar functions in the various industries. But where the application is such that it involves a portion of the manufacturing processes, a closer study of the entire method of manufacture is sometimes necessary. This is, however, desirable for many reasons —not the least being the fact that some time-worn methods are shown to be needless. Wasteful methods in japanning and enameling have been exposed. Poor oven construction, poor methods of loading, too many hours of baking, and too many men, are some of the defects brought to light.

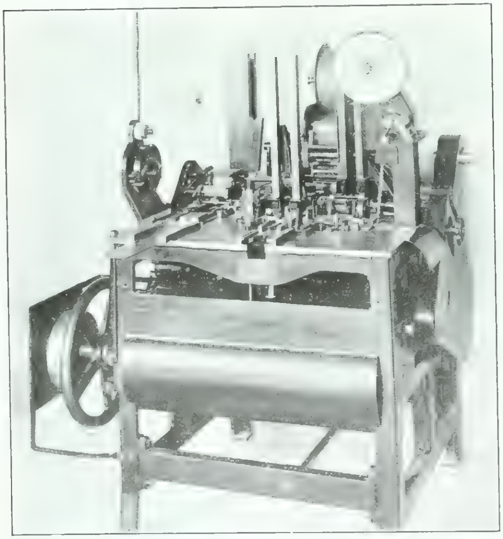


FIG. 9. PACKAGE SEALING MACHINE WITH CUTLER-HAMMER UNITS

During the past three years, not including 1918, electrically heated japanning ovens were placed in operation in nearly 100 American factories. On war work, or work essential to the production of goods vital to the carrying on of the war, many uses are made of electrically heated appliances such as tempering ovens for tools, dies and gages; rivet heaters; air heaters for dry rooms for aeroplane wings and for shell filling rooms; gun furnaces for shrinking gun jackets, tubes and rings; glue pots for aeroplane parts, rocket and flare cases, powder containers, and many others of equal importance.

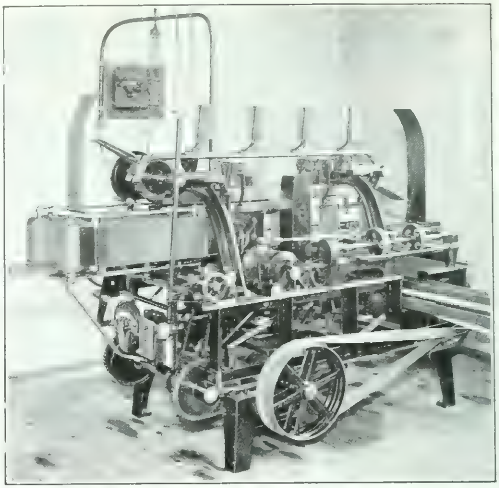


FIG. 10. ELECTRICALLY HEATED WAX WRAPPING MACHINE

Heating Oil in Tank Cars

An out-of-the-ordinary application was reported in the *Electrical World* in which an electric heater helped to free tank cars last winter. An immersion type heater was used to heat the oil in the tanks and the time required to empty them was reduced from three days to three hours. The shorter time required to empty saved sufficient demurrage charges to pay for the heater in a short time. It was equivalent to increasing trackage facilities at the industrial plant, and it likewise made it possible to obtain oil more rapidly with the existing facilities.

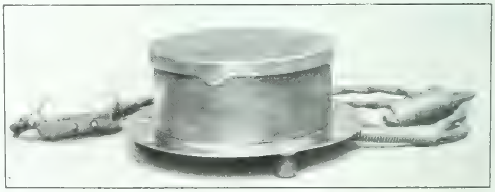


FIG. 11. ROUND TYPE HOT PLATE—3 DEGREES OF HEAT

It has frequently been pointed out that with the expected scarcity of coal during the coming winter the increased demand for oil for fuel may be expected to make itself felt in a way that will cause a shortage of tank cars. It is, therefore, not difficult to see that, with existing demurrage rates of $1, $2 and $3 for the first three days and $5 per day thereafter, an electric heater will prove a real economy where the winter is severe, as well as going a long way to reduce a tank car shortage.

A further illustration of the value of the immersion heater in this connection is to be found in the cocoanut-oil industry. Steamship lines at New York City have been able to save many days in unloading by using the heaters in the barrels so that oil can be quickly withdrawn.

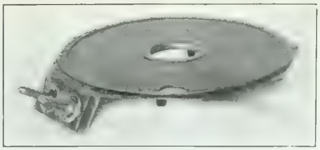


FIG 12. HEATER FOR FUSING MACHINE DIE

Foundries, box makers, bakeries, cereal manufacturers, munition plants, automobile plants, knitting mills, shoe factories, laundries, novelty manufacturers, clothing manufacturers, metalware manufacturers, and many others employ electricity in heating processes.

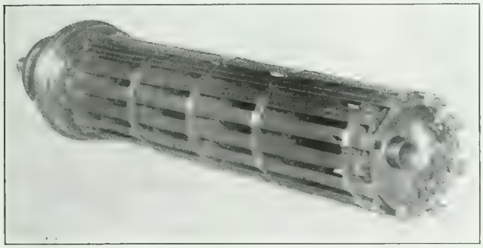


FIG. 13. PAPER ROLL HEATER SHOWING SIXTEEN UNITS

On a basis of gas at one dollar a thousand feet and electricity at three cents a kilowatt hour the operating costs of heat are identical. Comparative tests have been enlightening as showing that internal heating was 30 to 40 per cent. more efficient than when the heat was applied externally and had to be transmitted through the wall of a linotype pot. The actual operating cost in several cities has worked out about one cent an hour per pot, based upon actual meter tests.

Three Classes of Heating Equipment

Some of the apparatus is made specially for a particular duty of some industry; some has wider application; others may be used more generally in a large number of plants.

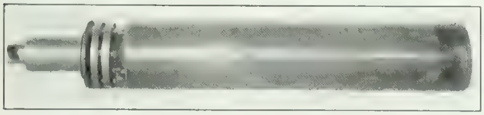


FIG. 14. LAUNDRY ROLL BODY IRONER, HEATING UNITS INSIDE

Such appliances as soldering irons, gluepots, branding irons, air heaters, solder pots, heavy irons, immersion heaters, may be used in a large number of plants and are more or less portable.

Equipment such as japanning ovens, drying and warming ovens, embossing press heads, flat irons, linotype pots, vat dryers, annealing furnaces, gun furnaces, etc., are made more or less for a specific operation.

FIG. 15. STEEL JACKETED SPACE HEATER ENCASED IN MICA

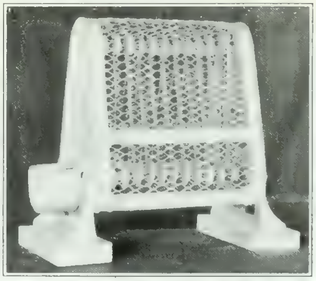


FIG. 16. CONVECTOR TYPE AIR HEATER

A third group includes still more specialized equipment, such as, electric furnaces for melting brass, steel melting furnaces and furnaces for heating, annealing and forging steel. These all operate at a temperature much higher than the nichrome resistor type of heater—1800 degrees Fahrenheit and over. The use of this type of apparatus, employing electricity for producing heat, has caused a big stir in the iron and steel industry. The United States is foremost in electric steel output with 233 furnaces not including this year's installations. Ten years ago there was one solitary electric furnace in this country and the total output for the year was only 55 tons. In 1917 the estimated tonnage was about a half million tons.

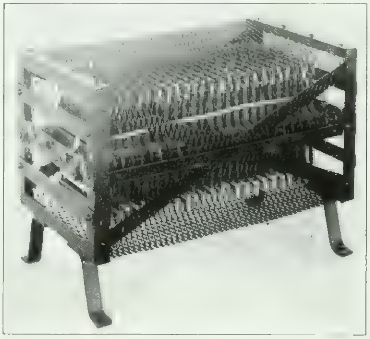


FIG. 17. GRID TYPE HEATER 5 KW CAPACITY

Under the heading of electrically heated furnaces are included: air tempering ovens or furnaces for carbon steel, for preheating high-speed steel, for annealing, metal melting, fusions, and many other similar uses.

Four Electrical Groups

The applications of electricity for heating purposes in the industries may be divided electrically into four groups. The widest and most varied includes all such applications where the heating unit is attached, imbedded or immersed, and heat is conducted to a liquid,

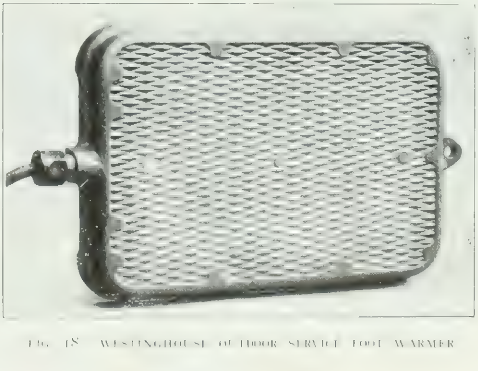


FIG. 18. WESTINGHOUSE OUTDOOR SERVICE FOOT WARMER

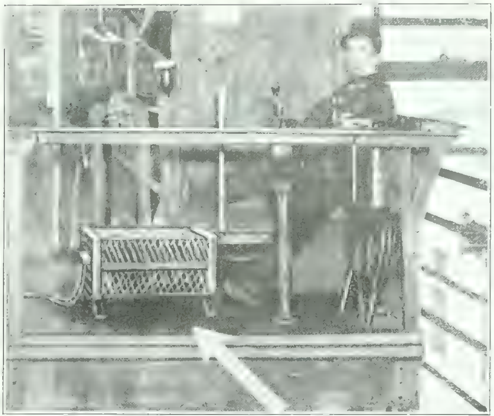


FIG. 19. HEATER FOR OUTDOOR OR INDOOR CRANE CABS

metal or other working surface. Examples of this class of applications are as follows: Soldering irons and pots; metal melting pots; glue cookers and pots; wax heaters; embossing and machine heads; various laundry and tailors' irons; sealing machine heaters; forming dies for paper cartons, cups and the like; printers' and engravers' stoves; chocolate warmers; celluloid heaters; industrial stoves.

A second group includes air or space heaters such as the following: Industrial heating units and heaters for crane cabs and other unheated or exposed rooms; ovens for drying, enameling, japanning and baking; plate warmers.

A third group includes furnaces: resistance furnaces and arc furnaces.

In the general applications as indicated in the first group, we find an unlimited field since the units may be used in flat strips, circular bands, or discs of sizes suitable for the work. This fact becomes apparent by referring to the illustrations Figures 1 to 15 inclusive.

In conduction heating, the heater unit is mounted in direct contact with the surface heated and heat passes to this surface by conduction. The more perfect the contact of the entire unit and surface, the more efficient and long-lived will be the apparatus. The steel-jacketed units are often used with the steel jacket welded to the surface metal of the embossing press, for instance, and then the jacket is pressed around the unit under hydraulic pressure. These units are used for temperatures of 550 to 750 degrees Fahrenheit, although these temperatures depend somewhat on the work which the appliance to which they are attached is designed to do.

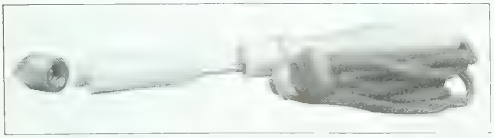


FIG. 20. ELECTRIC SOLDERING IRON—HEATER UNITS IN TIP

Immersion heating is frequently used where the whole enclosed unit is submerged in water, and may be used for other liquids such as oils and for lead and type metal baths. This encased type of immersion heater is used for temperatures up to about 850 degrees Fahrenheit.

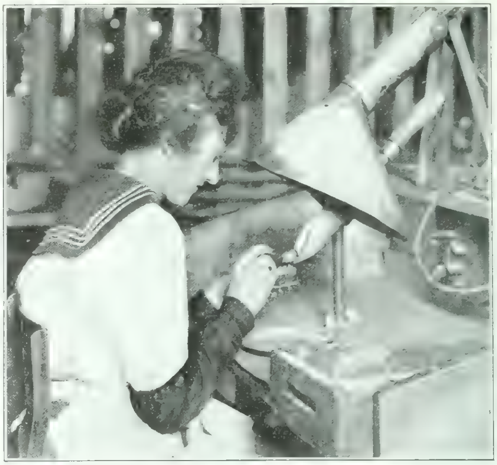


FIG. 21. SOLDERING IRON WITH SPECIAL TIP FOR SEALING WAX

PRINCIPAL APPLIANCES USED IN THE INDUSTRIES

Listed below are typical classes of industries and factories with the electrically heated apparatus or appliances which are used. There are many that are, of course, not mentioned because they pertain to certain individual cases that are more or less special but the ones mentioned cover those in general use today.

Apparatus	Rating in watts	Cents per hour, approx.
Laundry iron, 9-pound	600	2½
Tailors' iron	800	3⅓
Soldering iron, 1⅜-inch	250	1
Soldering iron, 1¾-inch	400	1½
Soldering iron, special, 1¾-inch	500	2
Industrial stove, 6 inches in diameter	550	2
Industrial stove, rectangular	800 to 3,200	3 to 13
Wax heating stove, for low temperature	375	1½
Space heater unit	500	2
Air heater, open-coil type	500 to 3,000	2 to 12
Air heater, grid type	5,000 to 10,000	20 to 40
Plate warmers	500 to 3,000	2 to 12
Immersion heaters, 3-inch disc	250	1
Immersion heaters, 5-inch disc	600	2½
Immersion heaters, bayonet type	150 to 3,600	½ to 15
Metal melting pots	400 to 550	2
Chocolate warmers	55 to 220	¼ to 1
Batch warmers	2,400 to 4,800	10 to 20
Hatters' hand shell	300 to 500	1½ to 2
Hatters' velouring stove	315 to 450	1½ to 2
Hat blocking iron	400	1¾
Curling machine iron	750	3
Hatters' flanging bag	440	1¾
Hatters' hand flat	550 to 700	2 to 3
Button die heater	100	½
Embossing head	100 to 1,000	½ to 4
Glue pot, one-pint	75 to 250	½ to 1
Glue pot, one-quart	75 to 250	½ to 1¼
Solder pot	250 to 800	1 to 3
Ovens	Depends on size and type	

Automobile companies
  Soldering irons
  Solder pots
  Glue pots
  Sad irons
  Furnaces for hardening
  Japanning ovens
  Enameling ovens

  Starch cookers
Machinery and tool manufacturers
  Air heaters
  Furnaces, heat treating
  Furnaces, resistance type for tools
  Furnaces for hardening

  - Paint and varnish heaters
  - Stoves
  - Oil tempering baths
  - Air heaters
  - Vulcanizers
  - Welders
- Bakeries and biscuit manufacturers
  - Bake ovens
  - Chocolate warming kettles
  - Electrically heated wrapper sealing machines
  - Soldering irons for sealing metal cartons in which biscuits are sent to the army in Europe
- Candy manufacturers
  - Batch warmers
  - Bonbon kettles
  - Chocolate warmers
  - Corn poppers
  - Gelatine cookers
  - Peanut roasters
  - Sealing and packing machines, electrically heated
- Electrical manufacturing plants
  - Furnaces
  - Ovens
  - Soldering irons
  - Solder pots
  - Welders
- Factory lunch rooms
  - Dish washers and dryers
  - Broilers
  - Urns
  - Food warmers
- Foundries
  - Air heaters
  - Annealing furnaces
  - Arc furnaces
  - Core drying ovens
  - Heat treating furnaces
  - Oil pre-heaters
- Furniture manufacturers
  - Air heaters
  - Creasing tools
  - Glue pots
  - Glue cookers
  - Paint, stain and varnish heaters
  - Wax knife heaters
- Hat manufacturers
  - Flanging bags
  - Hand shells or irons
  - Hand flats
  - Velouring stoves
- Knitting mills
  - Air heaters
  - Hosiery forms
  - Irons
  - Vaporizers
- Laundries and shirt factories
  - Cloth dryers
  - Collar formers
  - Cuff formers
  - Irons, laundry
  - Irons, shirt
  - Ironing machines
  - Pleating machines
  - Oil tempering baths
  - Soldering irons
  - Temper drawing ovens
  - Welders
- Metalware manufacturers
  - Air heaters
  - Enameling ovens
  - Japanning ovens
  - Japan tank heaters
  - Welders
- Miscellaneous manufacturers
  - Air heaters
  - Branding irons
  - Bacteriological ovens
  - Cauterizers
  - Disc stoves
  - Macaroni dryers
  - Sealing wax heaters
  - Sherardizing ovens
  - Vat dryers
  - Water heaters, etc.
- Munition plants
  - Air heaters
  - Drying ovens
  - Gun shrinking furnaces
  - Hardening furnaces
  - Heat treating furnaces
  - Oil tempering baths
  - Metal melting pots
  - Soldering irons
  - Solder pots
  - Welders
- Paper box factories
  - Box mold heaters
  - Drying ovens
  - Glue pots
  - Glue cookers
  - Wax heaters
- Publishing and printing establishments
  - Back rounders
  - Burnishers
  - Case coverers
  - Embossing die heaters
  - Engravers' stones
  - Gilding wheel heaters
  - Glue heaters
  - Gold leaf presses
  - Ink dryers
  - Linotype pots
  - Monotype pots
  - Matrix dryers
  - Pallets
  - Press heaters
- Shoe shops
  - Indentors
  - Knurling irons
  - Lining cementors
  - Relasters
  - Stitchers
  - Thread waxing machines
  - Turn and welt heaters
  - Welters
- Steel plants
  - Air heaters
  - Furnaces
  - Soldering irons
  - Welding equipment

Aside from the other advantages of electric heat for metal heating, the report made in the plant of the *New York World* by Mr. J. H. Vogt, chemical engineer, to Mr. James M. Lynch, New York State Commissioner of Labor is interesting. No lead was found in the atmosphere of the composing rooms in which there were 57 electrically heated linotype machines. In the monotype room, however, where there were nine monotypes all gas heated, a certain amount of lead was found. After this test the monotypes were equipped with electrically heated lead pots.

SPACE OR AIR HEATERS

It is a simple matter to extend an electric lighting circuit and add another lamp or group of lamps according to the conditions and amounts of light desired. This same flexibility is taken advantage of, in the way of heating such places as crane cabs, valve houses, signal and watch houses, turn table cabs, bridge houses, and various other locations where, because of exposure or physical conditions, heat or additional heat is required. Steel-jacketed electric heater units that look like two-foot rulers are connected to a lighting or power circuit like so many lamps and may be distributed where they will do the most good. Figure 15 shows the comparative size of this heating unit, the entire heating element of which is buried in an enclosure of mica around which the steel jacket is placed and sealed under an hydraulic pressure of about 20 tons. Two insulated eyelet holes are provided for mounting, and two connector posts serve for making the connections to the circuit.

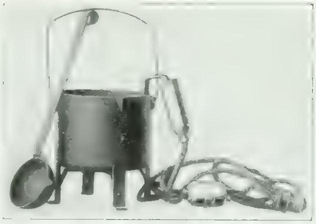


FIG. 22. ELECTRIC SOLDER POT

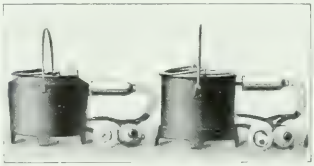


FIG. 23. TWO STYLES OF ELECTRIC GLUE POTS

Traffic officers, crane operators, signal men have employed this type of electric unit for keeping their feet warm. A heavy perforated metal plate is sometimes used supported about two inches above the floor with a unit or several units placed between—allowing an air space between the units as well as between the surfaces above and below to permit circulation. A current of warm air then passes up through the perforations. The size of the units, being 3/16 inch thick and 1½ inch wide make it possible to use them in a very small space.

These heaters may also be used for warming small ovens and drying cabinets where the temperature of the air surrounding the heater units does not exceed about 400 degrees Fahrenheit, and where the air circulates freely about the heater. Examples of this usage are, laundry dryers, film dryers, chemical dryers, sherardizing ovens, food warmers, etc.

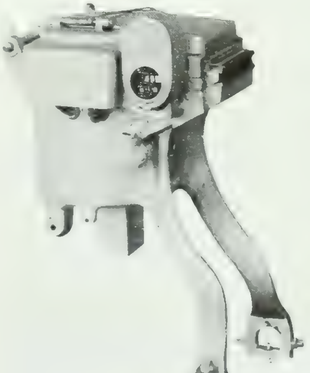


FIG. 24. ELECTRICALLY HEATED LINOTYPE POT

Other mill type electric heaters are made up as complete units, a few commonly used types being shown in the illustrations, Figures 16, 17, 18 and 19.

This type of heater unit may be also designed for higher temperature and for conduction heating by clamp-

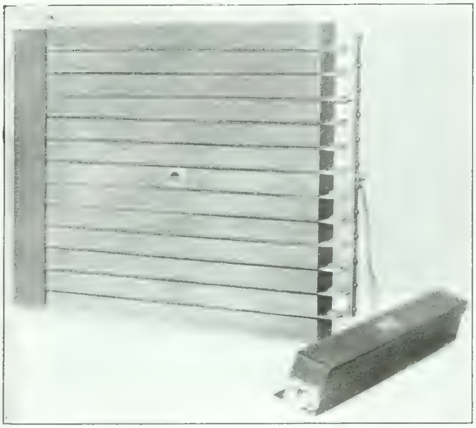


FIG. 25. REAR VIEW OF 15" X 15" ELECTRICALLY HEATED PRESS BLOCK

ing to press heads, plates, and in various forms to be used on packaging and sealing machines, dies, matrix tables, embossing blocks, paper rolls, ironing rolls, hot plates, etc. Some of these applications have been referred to previously.

Electric Soldering Irons Now Universally Used

Nearly every factory uses soldering irons either in production or in maintenance and repair work. Biscuit manufacturers recently jumped into the big user class by employing them for sealing the metal boxes in which crackers, biscuits, etc., are shipped to the boys in the Army. Girls do this work and the portability, cleanliness, and safety features made their use ideal. The number of motions as studied by an efficiency engineer are much fewer than with the iron heated in a gas furnace, besides the elimination of the gas fumes and impovershing of the air which is considerable where many gas heaters are used and many employed. From the fire hazard standpoint alone, the electric iron is worthy of its hire because of the great need for every building standing and the difficulty experienced in rebuilding should a fire occur.

In some irons the tip extends into a sleeve or socket around which the heater coils is wound, while in others the heater core extends up into the tip. One of the latter type is shown in Figure 20 with the removable tip shown removed. The heater coil is hermetically sealed in, to prevent moisture or acid flux entering. Tips are made in various sizes with blunt and pointed ends.

These irons are also used for sealing screw holes of switches with wax and for various other purposes. When supplied with a tip carrying a branding mark, they become branding irons, marking chocolates, meats, leather, light wood, etc.

FIG. 26. STRAWHATTERS' HAND HEATS IN USE

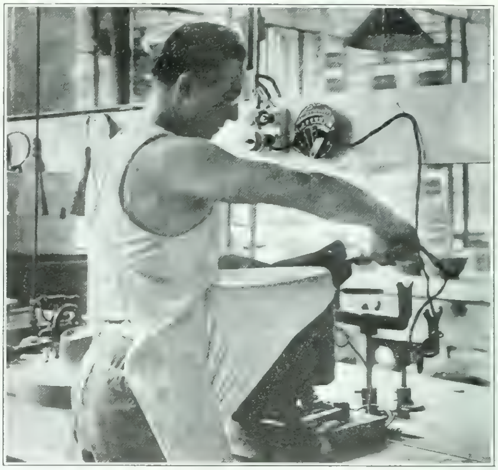


FIG. 27. ELECTRIC HAND HEAT FOR SHAPING FELT HATS

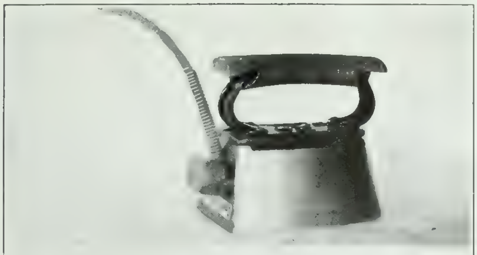
One method for covering screws in screw holes with wax is to mount an electric soldering iron tip downward at an angle of about 45 degrees and use a special tip so cut out and pointed that the operator simply rubs a piece of wax into the groove and a small stream of the liquid wax drips off the point into the hole in the object held just under the point. Figure 21 shows an iron used in this operation with details of tip.

To regulate the current to soldering irons used for some special purposes such as the above, a small rheostat is connected in the circuit. By this means the temperature is decreased as desired.

There has recently been brought out a useful little device known as the automatic rack for supporting electric soldering irons. As a matter of orderliness alone, this rack is desirable in any shop since it provides a definite, known place for the workman to place his iron when not in use. Soldering irons left on a bench with the current "on" overheat, which may result in the burning out of the heating unit or in setting fire to the bench or material near the iron. If the current is turned "off" the iron cools down to such a degree that considerable delay is caused when the iron is again wanted.

Heat is generated in the iron by passing electric current through the heater unit. When the iron is applied to the work heat is drawn from the tip of the iron into the other metal. As long as heat is thus drawn off and used properly there will be no excessive temperature of the iron and heater unit. If the work to which the iron tip is applied is too light in proportion to the iron or if the iron is not applied to any work and the current remains "on," little or no heat is conducted away with the result that the heater coil overheats.

The device mentioned above operates on the principle of the telephone receiver hook. Placing the iron on the support or hook bears this down and inserts resistance in circuit with the iron. This reduces the current consumed when the iron is not in actual use but allows enough current to reach the heater coil of the iron to prevent it from cooling off entirely. When the iron is lifted from the support the resistance which is carried at the back of the small slate panel is cut out of the soldering iron circuit and full current flows.



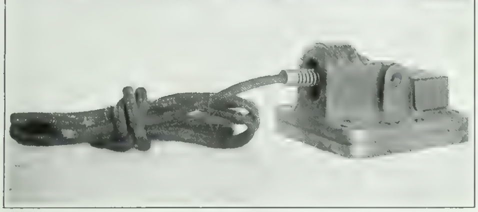


FIG 28 (ABOVE). HAT MANUFACTURERS' HAND SHELL

FIG. 29 (BELOW). HATTERS' DORAN MACHINE IRON

Where solder, lead, babbitt metal, tin, etc., are required in liquid form, the individual pot provides an economical labor-saving means for melting. See Figure 22.

Glue Cookers

Glue cookers or heaters are used in preference to glue pots where large quantities of glue are required, standard sizes being made in capacities from two to 50 gallons. Electric heaters of the "bayonet" type are employed arranged to give two heats, the maximum of which is used in the morning for about one-half to three-quarters of an hour, after which the current may be turned off entirely for several hours and then the minimum current turned on intermittently or continuously depending on the amount of glue used. The heaters warm the water in a jacket surrounding the glue vessel, and the jacket in turn is surrounded by an enclosure of mineral wool to retain the heat and reduce the amount of current used. Cookers of this type, it is claimed, consume such a small amount of current as to make them more economical than either steam or gas. If the glue has been soaked in water previous to being put into the cooker, the glue will be melted and brought up to a temperature of 150 degrees Fah. in one hour.

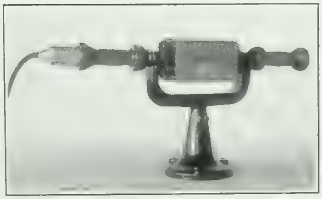


FIG. 30. HATTERS' HAND FLAT AND STAND

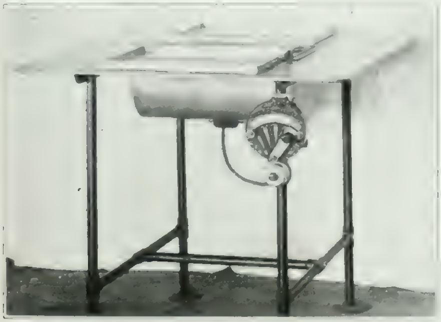


FIG. 31. CHOCOLATE DIPPING-TABLE WITH KETTLE AND SIDE PANS

Glue Pots

Portable types of glue pots may be taken to the work and connected to any socket or other electrical outlet. See Figure 23. Some of these are of the water jacket type, an immersion water-proof type of electric heater keeping the glue uniformly hot by heating the water. It is necessary to keep water up to a given level. In this immersion type, heat reaches the pot holding the glue by convection and radiation.

Jacketed types of glue pots, usually made of aluminum, have the heater unit in the bottom of the pot and heat the glue directly. The temperature of operation is about 180 degrees Fahrenheit. In the city of Chicago alone over 9,000 electrically heated glue pots are in use.

Metal Heating Pots

Linotype and monotype machines used for machine setting of type in newspaper and printing establishments are examples of metal heating that have been eminently successful. As the metal is equally heated throughout a high heat can be applied in starting and the metal very quickly brought to a liquid state. This is unsafe with gas on account of danger of cracking the pot.

Two heating units curved to fit the circular shape of the pot are immersed in the molten metal so that perfect conductivity of heat is obtained. Another heater unit is secured to the upper side of the mouthpiece and one to the underside and throat as shown in Figure 24.

The pot as shipped from the factory is adjusted for an operating temperature of 550 degrees Fahrenheit, with an automatic operating range of approximately 12 degrees from this point, making the total temperature variation during operation approximately 25 degrees. Thus, if you raise the normal operating temperature of the pot to 600 degrees, it means that the high heat will cut off at 612 and be automatically switched on again at 587 degrees.

In the industrial plant today, the medical departments have grown to be models of their kind. The sterilizer with immersion type heater, permitting the electrical sterilization of instruments in view of the patients which has a beneficial psychological effect on them. These appliances are built in various sizes.

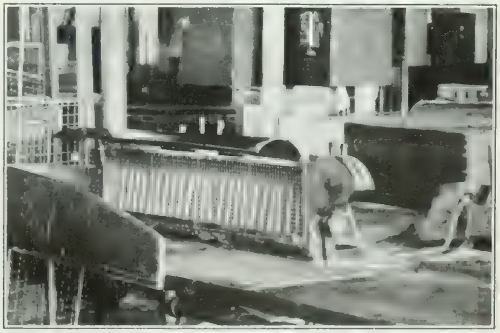


FIG. 32. ELECTRIC BATCH HEATER, USED IN SPINNING HARD CANDIES

An almost endless number of other applications could be referred to, but those mentioned give an idea of the possibilities. In the next installment electricity for oven and dry-room heating will be described.

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

The Employer and Money

By L. L. Warren

General Business Manager, Sherman Service, Inc.

As we live we learn, whether we realize it or not. The average employer who states that he has treated his employees more than square, undoubtedly has attached to his statement the one word "money." He thinks money the panacea of all ills.

Neither wage scales nor short working days will settle the labor problem. Mental satisfaction is the only satisfaction there is. The idle boy, girl, man or woman is a pitiful sight; they are the individuals who are always ill at ease, restless—something is wrong with them; they imagine the most foolish things possible. This is true in every environment of life whether we earn our livelihood with our hands or with our heads.

The labor problem is misnamed. The same problem that confronts the employer today confronts humanity as a whole, and it is the most simple thing in the world to realize fully that this entire question of the relationship of human beings rests upon three fundamentals which must be applied not only to the employer and employees, but to everyone throughout the universe; namely, self-education, help-education and gratification.

These may be otherwise described in the idealistic classification as: personal unbiased example, personal unbiased teaching, personal unbiased judgment. Money is not the answer; hours of labor are not the answer.

Can it be possible that anyone connected with labor believes that if any company, for example, turned over its entire business to its workers, that if it divided *pro rata* among them the entire profits of the organization after paying the lawful interest in exactly the same way and at the same time as those who are investors or officials—can it be possible that anyone believes that the thousands of workers employed by the company would be satisfied and remain in the employ of that concern? It is a pretty dream—but it is an awful joke.

Sobering Effect of Responsibility

I recently came to know of a certain concern engaged in a very peculiar business. Among their employees were several who did not believe they were being paid in proportion to the return upon the business which they were securing, and expressed themselves accordingly in a very polite way. The president, and nearly sole owner of that corporation, called three of these individuals into his office and told them that he would gladly turn over to them, if they would assume the obligations imposed under present conditions, all plants save two which belonged to this corporation.

It was a laughing matter to watch the faces of these individuals. They wanted their money every Saturday, and they wanted to know how much they got anyway, whether anybody made anything out of their efforts or not. They had not thought of the responsibility, financial and otherwise, which was upon the shoulders of their employers. They went back to their work contented and satisfied, realizing, because of their mental type, that there was something more than their efforts that concerned the business as a whole. They blew up higher than a kite when confronted with that one thing which makes all men stop and take notice, namely, responsibility and a chance of not making money.

Money Far from Being All

Why think that men are really different? We learn from those who have made a study of psychology that in the life and development of a man there is nothing that sets to work with greater secrecy than the construction of an idealistic personality, and money is not connected with it in any way. Some of the poorest men in the world were the greatest; some of the greatest inventors in the world were the poorest; the greatest artists, the greatest men in the professions have died paupers, but happy. Money does not buy happiness. This also applies to men of the physical type—a worker earning $3.00 per day is frequently much happier than one earning twice that amount with equal responsibilities, etc. If employers will only stop and think, will only analyze their own experience and apply the education of themselves upon a basis of nothing more or less than common sense, there can be but one judgment, that is, it pays to be thoughtful—not of money, not of hours, but of the minds of their workers, of the viewpoint of life and what it means.

Many an employer is letting fate run his business; many an employer believes that his workers are unappreciative; many a one believes that his workers must not be allowed to grow; and just because he does not present an objective for them to view, instead of growing for the mutual welfare of both, the *employee grows away from the employer,* becomes dissatisfied with the association which exists and either discontinues it or agitates where he is. As the result of agitation, the unrest which is in the mind of that worker multiplies itself and often swings through the entire working force, with the result that all become dissatisfied to the extent that production is held up. Then not only does the employer lose, but the workers lose two to one because they cannot stand the loss of time which strikes and decreased production entail.

Labor Problem a Mental Trouble

The labor problem is nothing more or less than a mental trouble. This is a conceded fact. If such is true, a mental application must be used to remedy this disease. Owing to the fact that workers are physical, their viewpoints must be handled from a different standpoint and an objective used which they can see and feel physically. By so doing it will revert back into their minds and cause them to become contented whether they are or not. But just the moment that an employer countenances and acquiesces to exorbitant demands, and gives himself and his plant over, bait, hook and sinker to labor he simply delays the day when something must occur to place the teacher where he belongs and the scholar at the desk. It is just as practical and just as sensible to allow the working forces to instruct the employer, as it is for the student in school to occupy the position of professor and the professor to be placed in the class.

The whole idea is turned all around, due solely to the fact, I am sure, that some employers have not considered this matter from the right standpoint, and seemingly will not do this when it comes to satisfying their workers. Such a one is the type of individual who thinks that money is the cure for all evil. It is not money that will satisfy labor—it is honest, sincere treatment and the gratification of an objective which is not removed.

* * * *

Labor Turnover – Discussion

By E. Goldberger

Efficiency Engineer, Packard Motor Car Company

I HAVE read with great interest the questionnaire and answers in the September issue of INDUSTRIAL MANAGEMENT in regard to labor turnover, and notice that the concensus of opinion differs so much from the standards adopted by the National Employment Manager's Conference and, later, by the United States Department of Labor, that it seems these standards will have to be revised.

We have investigated this proposition repeatedly and the following method, adopted and applied in our works, may be of interest at the present time. Two charts help in understanding the method.

Figure 1 shows:

A. Grand total of men employed in the division.

B. Total number of men hired during one week preceding the date marked on the horizontal coördinate (this includes new men, rehired, re-instated and transferred in).

C. Total number of men paid off during one week preceding date marked (includes, resigned, laid off, discharged and transferred out).

D. Total number of men hired during four weeks preceding date.

E. Total number of men paid off during four weeks preceding date.

For figuring the labor turnover I have adopted a new standard that gives a better index as to the labor condition in a division.

1. Instead of one week's figure for hired or paid men, I take the total of four consecutive weeks, which then gives an evener slope in the curves expressing turnover tendencies.

One week is too short a period from which to draw any intelligent conclusion, since the variation between two following weeks might represent a couple of hundred per cent.

2. The total number of men that have been hired and been paid off, *i. e.*, actually replaced, represents a complete turnover, and if there be an excess of men hired over paid off, they actually are to be accounted to increase in force, while if there be an excess of men paid off, they represent a decrease in force.

The term "fluctuation of labor" (+ if increasing the force, — if decreasing) is used to express these figures, since it leaves the term "turnover of labor," to represent only what its name implies.

It is important to make this distinction, since avoiding a higher labor turnover calls for one type of preventatives in the employment and factory departments, while a high fluctuation is either unavoidable or the preventative means must be taken in the production and sales departments.

3. To avoid using the information after it has become one month old, from month to month I figure the turnover and fluctuation every week for the past four weeks; this gives 52 chances for intervention instead of only 12 per year.

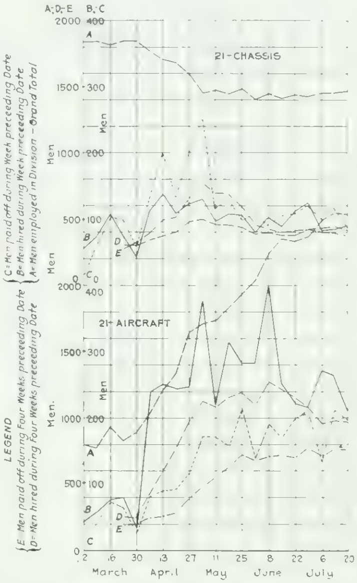


FIG. I. CHART OF THE VITAL STATISTICS OF EMPLOYMENT

The labor turnover, then, is the ratio between the total *replacements* in a division during the four weeks preceding the date of figuring, and the grand total of men employed (on our books) at the end of that period. This figure multiplied by 13 gives the labor turnover percentage reduced to a yearly basis.

The above rule naturally implies that if a man has left for certain reasons, and another one has been hired during the four weeks following his departure, a *replacement* has taken place which has to be accounted into turnover, but if he be not replaced at all, or replaced only after more than four weeks, it is accounted as fluctuation.

Figure 2 gives both the turnover and the fluctuation (above the 0 line if increasing, below if decreasing the department's force). They are both figured in per cent. (*i. e.*, taken over the total number of men employed in that division during that week). The figures on the left side of the column read the percentage for the elapsed four weeks (almost a month) and those on the right side the same, reduced to a yearly basis.

The prevailing practice in figuring labor turnover is: Multiply the number of men hired (or leaving) each week by 52 and divide the result by the grand total of employees. This leads to wrong conclusions since it is neither the hired, nor the leaving men that constitute the basis of labor turnover.

Both methods (hired or leaving men as basis for turnover) and their error appear in Figure 1, where in two different divisions the conditions are directly opposed. Either way of figuring would affect, considerably the factor representing turnover. Actually, the true turnover cannot be so different in two divisions under the same management and same scale of wages.

Of course, the same conclusions could be drawn if, instead of two divisions, we would consider two plants.

The following remarks amplify the preceding:

1. *Transfers in or out* are always counted as hirings or leavings, keeping in mind, of course, that a man transferred from one department to another one of the same division is to be figured in the departmental turnover but not in the divisional turnover.

2. *Number of men on the books or men actually working.* There are more reasons in favor of counting the men on our books rather than those really attending, as some men leave without notice, passing through a transitory stage of not attending and still being on the books; so that, when they leave and are counted in the turnover, they do not represent the turnover of the force working, but of that on our books.

b. It is much easier to count the men on the books than those attending, as the first information can be made available quickly in the employment office, while the last one has to be made available by many clerks in different departments or by the time office.

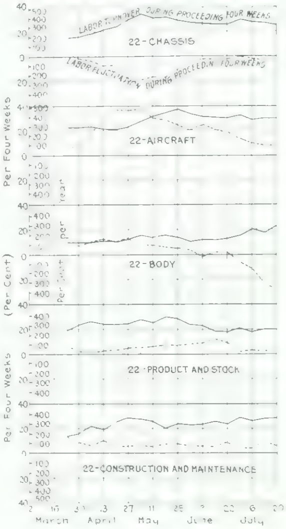


FIG. 2—CHART OF LABOR TURNOVER AND LABOR FLUCTUATIONS—TWO DEPARTMENTS

c. The disturbance of the balance of forces in the industrial conditions of the country has compelled us to consider the problem of labor turnover. It is very likely that high wages, where they are unwarranted, will force us to face the problem of absentees, and to study a standard coefficient of attendance. There can be no doubt but that this is represented by the ratio of elapsed straight man hours (*i. e.*, not including overtime) over total available man hours on the books (similar to the ratio of output over input in any power machine). This is, in my opinion, a good enough reason to keep the same denominator for all three coefficients, labor turnover, labor fluctuation and labor attendance.

3. *Standard period.* A day or a week are too short periods from which to draw intelligent conclusions (see the figures), and a four-weeks' period has an advantage over a monthly period since the last one varies almost 10 per cent. in length, which would also affect our coefficients. It takes about one hour per week to plot the curves shown for all 15 divisions of our plant.

4. *Unavoidable replacements.* Employment managers like to see the turnover figures as low as possible and favor eliminating the "unavoidable replacements" from the figures expressing turnover. There are, however, two reasons why we have preferred not to make this elimination. First, the unavoidable replacements cost just as much money as the other ones, and, second, how are we going to agree upon a standard deciding what is and what is not an unavoidable replacement?

5. *Average number of men on payroll.* It would be more correct, from a mathematical standpoint, to take as the denominator of the ratio expressing the labor turnover the *average* number of men on the payroll during the four weeks preceding the computing of the turnover percentage. To do this, we would have to take one-fourth of the sum of all men on the books on every one of the four weeks. This would be a trifle more complicated than to take the number on the books at the end of the four weeks period (as we now do) and would be only a trifle more correct for practical purposes. A standard should be agreed upon in this case.

Book Review

The Coal Catalog, combined with the Coal Field Directory. Six hundred and seventy-one 9 by 12 pages; numerous illustrations; cloth bound. The Keystone Consolidated Publishing Company, Pittsburgh, Penn. Price, $25.

This catalog and directory is an annual volume relating to the coal fields of the United States and providing in a compact and convenient form a large amount of information of interest to the producer and consumer of coal, sales agencies, industries using coal, railroads, mining engineers, geologists and educational institutions. The descriptive matter in its pages has been gathered from various authoritative sources. The tabular matter and the directory of mines have been made up from information on file with the editor and gathered by direct correspondence with mines or their sales agencies.

The ten features of the "Coal Catalog" are: Geology of coal; coal fields of the United States; classification of coals; analysis of coals; preparation of coal; the coal producing states; seams in the United States classified according to rank, usage and physical structure; analysis of seams by counties; list of mines by seams; directory.

The scheme of the book and the editorial treatment of the matter that it contains makes this volume a cyclopaedia of coal mining knowledge presented in such language that the essential facts are easily grasped. It is without doubt the most complete, authentic and standardized work of its kind ever published.

The fuel situation of the past year has brought the consumer of coal face to face with serious problems. No longer can he merely judge coal by its cost. He must now know the kind of fuel he is buying and whether or not it is adapted to his particular needs. Information of this kind the "Coal Catalog" supplies and in so doing ministers to a direct need of every coal purchaser.

The space given to the geology of coal including geological and mining terms is only 31 pages. Then opens the section describing the coal areas of the United States including a map on which the coal fields are plainly delineated. Then follows the classification of coal, and this section of the work the purchaser will find of great interest and value. The first in classification is "according to rank," that is according to the degree of mineralization, the second "according to use" and the third "according to physical structure." Under these classifications the purchaser is informed regarding the type of coal that will best suit his particular purpose, whether he needs it for raising steam, in preparing powdered coal, in the manufacture of producer gas, in smithing and forging, in making water gas, manufacturing illuminating gas, for locomotives, in metallurgical processes, for coking, bunkering, cement burning, or for domestic use.

Because of numerous changes that are continually being made in the operating officials of coal mines and the beginning of new enterprises the publishers issue eight bulletins during the year, listing these new operations, developments, consolidations, changes in officials and the like. This bulletin service is supplied to every purchaser of "Coal Catalog" without further charge.

The book is an excellent example of the printers' art and is bound in blue cloth with gold lettering.

Editorials and Comment

First Lieutenant Walter Ives, formerly vice president of The Engineering Magazine Company, publishers of INDUSTRIAL MANAGEMENT, was awarded the Croix de Guerre in France on July 16. He went to Europe in June, 1917, with an ambulance unit from the City Club of New York City and has since been attached to the French Army. He has seen some of the heaviest fighting of the war, having been in the battle of Verdun a year ago. His honor was awarded for gallantry and determination in bringing in his car with its wounded men, after the two immediately preceding ambulances had been destroyed by shell fire and when his own driver was overcome with gas.

The former secretary of The Engineering Magazine Company is also in France, Second Lieutenant John R. Dunlap, Jr., attached to the Aviation Corps of the United States Army.

* * * *

Dr. Frederick W. Taylor's object in writing his book "Shop Management" was to call attention to the mechanism of time study and make sure that it should receive the consideration that it deserves. On fifty-two pages of that book there are references to time study, and on page 58 is this paragraph:

> The writer most sincerely trusts that his leading object in writing this book will not be overlooked, and that scientific time study will receive the attention that it merits.

A number of years before this book was written Dr. Taylor pointed out the need of supplying proper information to rate-fixing departments in his paper "A Piece Rate System" presented to the American Society of Mechanical Engineers in 1895. The following quotation shows his viewpoint:

> Practically the greatest need felt in an establishment wishing to start a rate-fixing department is the lack of data as to the proper rate of speed at which work should be done. There are hundreds of operations which are common to most large establishments, yet each concern studies the speed problem for itself, and days of labor are wasted in what should be settled once for all, and recorded in a form which is available to all manufacturers.
>
> What is needed is a handbook on the speed with which work can be done, similar to the elementary engineering handbooks. And the writer ventures to predict that such a book will before long be forthcoming. Such a book should describe the best methods of making, recording, tabulating, and indexing time observations, since much time and effort are wasted by the adoption of inferior methods.

If any proof is needed as to the interest of industrial executives and mechanical engineers in this subject at this time it is amply supplied by the remarkable response to the articles on "Time Study as a Basis for Rate Setting" by Mr. Dwight V. Merrick, the last section of which appears in this issue. INDUSTRIAL MANAGEMENT has received numerous requests to put this matter into book form and this is about to be done.

* * * *

It is unquestionably true that cost accountants have had much to do with the installation of better management methods in industrial plants. The reason is perhaps not far to seek. One of the first needs that is recognized when a manufacturing organization is infected with the germs of progress is for better cost information. And who should supply this but the cost accountant? As time went on, however, and the art and science of industrial management began to emerge from swaddling clothes into the stature of sturdy youth, progressive leaders who were carrying forward this youngster's banner began to disapprove in an unconcealed manner of many of the principles and actions of cost accounting. The engineer and the cost accountant locked horns.

It is possible that the latter thought that the former was trying to push him out of executive positions in industry, and it is quite true that the former accused the latter of being reactionary and of hindering production instead of furthering it.

An interesting sidelight on this situation is given by Mr. G. Charter Harrison in his series "Cost Accounting to Aid Production" now running in this magazine. Mr. Harrison received his training as a cost accountant, has practiced this profession for many years and is, therefore, especially qualified to express his opinion of cost accounting in industry as it is and as it should be. Unqualifiedly, he takes the side of the engineer, saying that cost accounting is behind the times, has failed to apply well recognized principles and has not measured up to its opportunities. But instead of seeing a hopeless situation for the cost accountant he forecasts a bright future if he will but apply the established principles of management and become an aid and supporter of all the other efforts of production.

* * * *

Away back in the last months of 1914, when the tremendous military power of Germany was crushing right and left, many wondered when and where it would be stopped, and the remark was often made, "Now efficiency is being put to the test." Germany was held up before the world as the land of superior materialistic efficiency, for every ounce of material and every bit of human effort was directed toward a common end, and there was no such thing as frittering away anything that might strengthen the Fatherland. It was autocratic efficiency supreme. With the outbreak of war this national structure that had been created through 40 years of the work of an entire people was pitted against the acknowledged inefficiencies of democracies. The question was, could democracies with their admitted inefficiency in things stand against the superior materialistic efficiency of Germany? We have had to wait over four years for the answer, but now it is written so unmistakably that the whole world knows. A democracy that makes men first and soldiers second is more than a match for any autocracy, even though the latter may be superior in materialistic things. Germany's war machine was built during four decades, while the best ideas of the industrial and scientfic world were grouped together and applied to the problem of killing men. In a little more than one year the United States built a war machine that Germany cannot break. Democracy is vindicated.

* * *

In these columns of the October issue, Industrial Management referred to the shipyard situation asking the searching question, "Does not the root of the difficulty lie in mismanagement and lack of management? This viewpoint is completely supported by the leading article in this issue written by Mr. W. L. Churchill. The country realizes that there is a very definite shipbuilding problem and now an industrial engineer, who has made an investigation of the conditions in some 20 shipyards, states flatfootedly that the solution is "management." So why not definitely place the function of management alongside of all the others that are being administered by the Emergency Fleet Corporation.

The people of the United States are vitally interested in the merchant ships that are completed and put into operation. They want to know that ships are carrying cargo, for that means support of our boys overseas and of our allies in Europe. For some reason or other our attention has been fixed upon launchings, that is upon the sliding into the water of a steel, or wooden, or composite box. But in reality we are interested in the deliveries made by the Emergency Fleet Corporation, that is, in the number of vessels that are fully completed ready to receive a load of wheat or munitions or other war supplies and sail for "over there." It is evident that a hull must be launched before a vessel can be completed, but it is likewise evident that a hull without machinery or fittings cannot be used as a cargo carrier. Why not talk more about deliveries and less about launchings?

* * *

When skilled labor was abundant, setting tasks and paying bonus to all those who reached the standard set provided a means to build up the working force by a process of careful selection and to maintain the necessary output. Present conditions in regard to labor have changed all this, however, and now the setting of tasks and recording individual production is the means being used in a few progressive plants to pick out the workers that need training and help, and to show the spots where production is lagging. It also opens up a great field for the executive activities of foremen. No longer can the men directly in charge of employees in production claims that there is no executive work left for them to do. Once tasks are set and records of output kept, foremen have the opportunity to help those who are not making the task by encouragement and teaching. From another angle the accumulated records of the progress of the employees is a measure of the efficiency of the foremanship. The foreman who is "on to his job" will look after the weak spots, and the degree with which he does this will show his own worth and the success or failure of his efforts to train, instruct, lead and guide the workers for whom he is responsible.

* * *

In some quarters there has been a tendency to compare our airplane manufacturing program and our shipbuilding efforts. But is there much similarity except that each is a huge national undertaking directed toward winning the war? A merchant ship is rather a crude product mechanically, has no military use, is not operated by military men, is not brought in direct competition with any similar structure built by the enemy, and does not of necessity expose men who are upon it to the risk of death. How different is the airplane! It is a fighting machine, it is operated by military men, is put into direct competition with similar and perhaps better machines produced by the enemy, and every flight that it makes brings peril to the men who are flying in it. Put a little differently, any good cargo boat will carry goods to Europe, but only the most highly perfected airplane can be permitted to fly over the fighting front. In one case the simple needs of transportation must be met, in the other the superior needs of the army upon whose efforts depend the winning or loss of battles, success or failure in campaigns and the fate of nations. An article on page 375 amplifies this viewpoint in its relation to modifications and changes in airplane design.

* * * *

Mr. A. H. Krom, Director of Engineering United States Employment Service has sent a letter to the presidents of the technical societies of this country urging them to use their official influence to continue the activities which they represent. He counsels them not to be discouraged because of war demands, suggests that they originate plans for professional development and hopes that they will shoulder new responsibilities saying, "Now as never before, the engineer and the engineering profession are conceded that place in the world's estimation so long coveted and deserved." There is at least one society to which Mr. Krom should not have sent his communication, namely, the American Society of Mechanical Engineers. Since the outbreak of the war its membership has increased 3578, for every year of this period its income has exceeded all expenditures leaving a handsome surplus, all of its regular activities have been expanded, and many new responsibilities have been undertaken. It looks as if some of the weaker sisters among the technical societies had been pouring a tale of woe into Mr. Krom's ear. What a pity that he did not look up the American Society of Mechanical Engineers and find the silver lining for his gloomy cloud.

* * * *

Do you know of any alien property? If so, it is your duty to report it to the Alien Property Custodian in Washington, and do you appreciate that under the heading of alien property are included patents, trademarks, copyrights, prints, labels and designs? In connection with all of these the following persons are required to make a report:

All persons who are in any manner interested in the use or operation of any enemy owned plant, trade-mark, copyright, print, label, or design, including joint inventors, where one of the inventors is an enemy within the provisions of the "Trading with the Enemy Act."

Assignees of an undivided part or share of an invention, or right to carry on a process or operate under a trade-mark, copyright, print, label, or design within and throughout a specified portion of the United States, when such patent or process is enemy owned.

Mortgagees and licensees of enemy owned patents, trade-marks, copyrights, prints, labels or licenses.

The above includes guardians, executors, and administrators.

* * * *

By leaps and bounds the use of electric current for industrial lighting has sprung on from one application to another until now the manufactured products of the world are made either in day shine or electric light shine. Are we about to see this record repeated in the utilization of industrial devices employing heat developed by electricity? There seems to be some reason for believing that this will come true. The actual cost of the current for producing the heat is a small item compared with other advantages, such as flexibility, certainty, cleanliness and accurate temperature control. And usually the current cost is far overshadowed by the value of increased product and lessening of spoilage.

Training schools for employees now established in many industries are here to stay. More progress has been made in their installation during the last year than in all the preceding nine that elapsed since Mr. H. L. Gantt presented his epoch marking paper in the progress of industrial management before the American Society of Mechanical Engineers on "Training Workmen in Habits of Industry and Coöperation." Wherever such a school is opened there is indicated a sympathy with the workers and their needs that perhaps was unlooked for. The results from every such course in training demonstrate that it pays, and there are other advantages that may be grasped if we will, and after all, these schools are destined to have a powerful, constructive influence on after-the-war industry.

* * * *

Mr. John Wanamaker, in a recent address answers the question, "After the war what?" in this manner:

> While it is only my opinion, yet, after careful reflection, I am willing to say that it is my belief that the ensuing four years after the war are likely to be the most prosperous four years ever known in the United States. I urge that we bring forward the fat years by pouring out all our strength to get the war finished this year.

Such an opinion from one of America's most famous and successful merchants, is good medicine for the old fogies who are now predicting hard times after the war.

* * * *

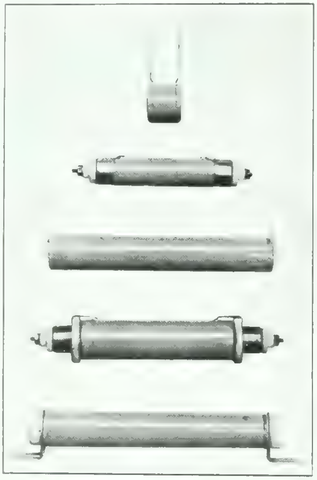
This issue of Industrial Management contains the final installment of Mr. Walter N. Polakov's series "Mastering Power Production." All of these papers have been received with appreciation as evidenced by the numerous letters that have reached the editor's desk. A recent one says: "I think the articles [Mr. Polakov's] in Industrial Management constitute one of the most noteworthy contributions to the power plant problems that we have had in years."

Factory Equipment News

The Latest Labor-Saving Machinery

Enameled Resistance Units for Current Regulation

ENAMELED resistance units for regulating current have been developed in various forms and sizes, as shown by the accompanying illustration of products of the General Electric Company, Schenectady, New York. Some of the applications of these units are in connection with railway and fire alarm signals, fractional horsepower motors and in series with relay contactor and circuit breaker coils on panels and switchboards. They are of particular service where moisture and dampness are present and where there is liability of sudden changes in temperature or of high temperatures.



ENAMELED RESISTANCE UNITS

The resistance wire is wound either upon a steel body coated with a special refractory enamel or paint, or upon a high heat resisting silicate compound developed to withstand temperature changes without cracking or being injured. A steel body is preferred for extreme lengths where strength is necessary to cross the span. The refractory silicate body is used for most of the ordinary types of resistance.

After being wound upon the body the resistance wire is embedded in a blue vitreous enamel and is fused at a high temperature until it has a uniform glossy structure. Several different methods of attachment to the circuit have been developed, as indicated in the illustration.

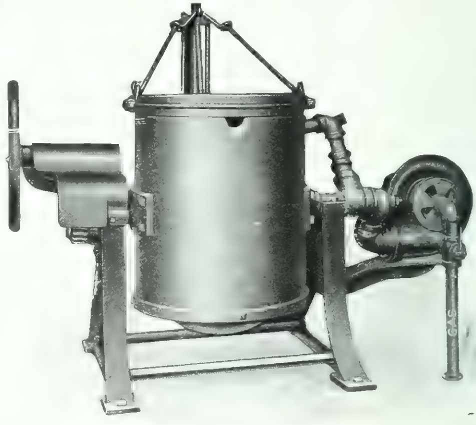
* * *

Monarch Metal Melting Furnace

A FRONT view of a Monarch vertical non-crucible tilting metal furnace equipped with a motor driven blower and adapted for gas or oil fuel is shown in the accompanying illustration. It has been developed to meet the need for a small quick melting non-crucible furnace and is adapted for general foundry practice except where the mixtures have a zinc content of 40 per cent. or more. Either gas or oil fuel may be used, and each furnace is so arranged that it can be changed from one fuel to another with a small expenditure of time and money.

The furnace is provided with a removable cover thus promoting the charging of large pieces of metal. Furthermore, light scrap can be rapidly charged because of the large opening which is available when the cover is moved to one side. The furnace bottom is rounded, making the cleaning a simple operation. The tilting mechanism is of the worm gear type and the furnace stays set at any angle desired and cannot tip forward or backward accidentally.

The bottom of the furnace is rammed up with a carborundum mixture, or with any other high temperature heat resisting material. The sides are lined with 4½ inches of firebrick. The bottom of the furnace may be removed and replaced without disturbing the side lining.



MONARCH METAL FURNACE

The melting capacity of the furnace is approximately 400 pounds per heat. The length of time required to melt a charge runs from 40 to 60 minutes.

The furnace is manufactured by the Monarch Engineering & Manufacturing Company, Baltimore, Md.

* * *

Portable Belt Conveyor

THE portable belt conveyor shown herewith is made in lengths varying from 12 to 60 feet as self-contained units. It is manufactured by the Barber-Greene Conveyor Co., Aurora, Illinois, and is known as "style A." The frame is a development of the Warren truss made on a sectional basis with all of the members standardized. All parts are punched to gage, thus insuring interchangeability and ease in extending the conveyor by the insertion of additional sections. The standard drive and discharged ends together form a 15-foot conveyor. The standard intermediate sections are made in 3, 6, 9, 12 and 15-foot lengths, giving a range of lengths for the conveyor in multiples of 3 feet.

The pulleys are pressed steel, provided with a screw adjustment to take up the stretch in the belt and to permit of proper training of the belt. The belt is a special rubber conveyor belt with "cushion edge," or a heavily oiled and stitched canvas conveyor belt can be supplied.

The drive is from a standard motor through cut gears and sprockets with malleable pin chain. The receiving hopper is of steel. Both drive and motor are completely housed to protect against damage and weather.

PORTABLE BELT CONVEYOR IN USE

These carriers have been developed to meet the three requirements of strength, lightness and durability. The type is the three-roll trough carrier to keep the material in the center of the belt. These carriers are placed three feet apart and the return rolls are spaced approximately nine feet apart. Guide rolls are only required on the longer rolls. These conveyors are adapted for handling many kinds of material around industrial plants and especially for the conveying of coal.

* * * *

Automatic Chemical Fire Extinguisher

THE high degree of protection against fire in industrial buildings given by an installation of automatic sprinklers is universally recognized. But until recently little consideration has been given to protecting with sprinklers small buildings and those involving comparatively low values. However, a system has been developed by the Sypho-Chemical Sprinkler Corporation, New York City, to provide this kind of protection in buildings where the regular water sprinkler system has not been considered feasible for installation.

In devising this system the sprinkler head has been retained as the automatic element and is used to bring into operation a powerful chemical extinguisher similar to that now so universally used by city fire departments.

The system is self-contained, having no water connections, gravity tank or under-ground piping. It comprises a tank filled with 200 gallons of soda solution, which is usually located in the basement, but if a number of floors are protected, the tank is located so that it will not be lower than 60 feet from the highest sprinkler head; communicating with the tank are receptacles holding sulphuric acid; a 2-inch riser pipe extends from the tank to a few feet above the roof of the building, terminating in an expansion chamber; a small suction pipe runs through the riser pipe from the expansion chamber to the acid receptacles; branching off from the riser pipe on each floor are 1¼-inch cross mains and ¾-inch distributing lines; sprinkler heads are spaced a few feet apart on these distributing lines. All pipe lines are filled with a non-freezing fluid. A combination stop and check valve is located in the riser pipe immediately above the tank and is so constructed that it can only be closed when pressure is on the system. Exterior and interior alarms are provided and are postively actuated by gas pressure deflecting diaphragms.

As soon as heat opens a head, the liquid level is reduced in the expansion chamber and a partial vacuum is created in the suction pipe connected to the acid receptacles. This suction causes acid to be siphoned into the soda solution and an initial pressure of from 80 to 100 pounds gage is generated; further acid is automatically supplied to continue the necessary gas generation and hold the pressure. The pressure opens the check valve and the fluid is forced out through the opened sprinkler head upon the fire area in the form of a heavy spray. Upon the generation of pressure both alarms are put into operation.

There are no pistons, valves or other moving parts incident to the generation of pressure, other than in the automatic sprinkler head.

This chemical system has been approved by the Underwriters Laboratories, Inc., for use where not more than three sprinkler heads are expected to control a fire with 200 gallons of chemical solution. It is applicable in buildings where there are no flash fire hazards, unusually high ceilings or excessive draft conditions. A system consisting of one chemical engine and the necessary piping will protect a building not exceeding an area of from 35,000 to 40,000 square feet.

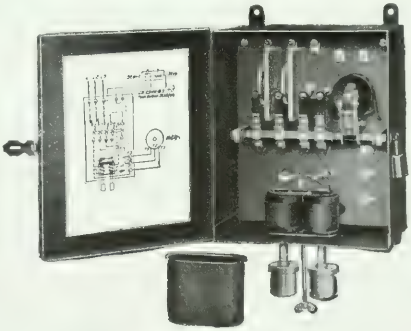
Among the types of risks now under this protection are leather industries,, printing establishments, tobacco concerns and metal working establishments.

The use of non-freezing solution in the pipe lines makes this system applicable to buildings having little or no heat. The system being self-contained, is also applicable to isolated buildings having no connection with city water mains.

* * * *

Steel Switching Cabinets

AN all steel switching cabinet made in units for single-quarter- or three-phase circuits in capacities up to 300 amperes at 15,000 volts, and 800 amperes at 600 volts is shown in the accompanying halftone. All of the current carrying parts are enclosed and provision is made to bring the leads out at top, bottom or sides of the unit. The unit consists primarily of instrument transformers, oil circuit breakers and disconnecting switches enclosed in a sheet steel compartment with the instruments, operating levers, etc., mounted on the steel front.



G. E. ALL STEEL SWITCHING CABINET

The main switching apparatus consists of a standard switchboard type oil circuit breaker operated in the usual manner. This breaker is mechanically interlocked with the disconnecting switch so that this switch cannot be opened or closed while the oil circuit breaker is closed. The disconnecting switch is operated from the front of the panel, and is so interlocked that the rear door cannot be opened while the switch is closed, nor can the switch be closed while the door is open. These features are a safeguard against gaining admittance to the compartment while the current carrying parts are alive. This apparatus has been designed for use as distribution and tying-in switches, control switches for induction and synchronous motors, and the like. It can be made nearly water, gas and dust proof, and for that reason is especially adapted to industrial uses where fumes and dust are present. It is made by the General Electric Company, Schenectady, New York.

* * * *

Standardized Wooden Buildings

THE steel situation in the United States has limited building construction to the point where even essential industries are disturbed over the difficulties of obtaining necessary additions to plant. To meet this situation and respect the Government's requirements the Austin Company, Cleveland, Ohio, has brought out a complete line of standard industrial buildings to be built of wood. In general they are duplications of the 10 Austin standard types that have been fabricated of steel. The dimensions, ventilation, lighting and clearance are essentially the same. The trusses, although of the same dimensions and loading value, are designed of wood. One set of designs shows a lattice truss requiring no steel for its construction. Another, known as the timber truss, requires a few steel rods only.

The sash for these buildings is of wood retaining practically the same dimensions and glass areas as before in steel.

The fact that these bulidings are in general dimensions and type duplicates of those standardized in steel permits the addition of a wooden extension of existing steel buildings without any serious variations in appearance or utility.

Personal and Business Items

The Shepard Electric Crane & Hoist Company announce the appointment of Mr. A. J. Barnes as export manager, with headquarters at Montour Falls, N. Y.

* * * *

Mr. Payne G. West has been appointed assistant manager of field sales for the Lakewood Engineering Company, Cleveland, O.

* * * *

Mr. J. W. Wellington has been made general manager of the Dauch Manufacturing Company, of Sandusky, Ohio.

* * * *

Mr. L. E. Wilson has been appointed general sales manager of the Dauch Manufacturing Company, Sandusky, Ohio.

* * *

The R. H. Beaumont Company, Philadelphia, Pennsylvania, has just issued catalog No. 38 describing and illustrating the Beaumont drag scraper for the ground storage of coal.

* * * *

Mr. A. G. LaPierre has recently been appointed traffic manager of the Chicago Pneumatic Tool Company, and Mr. F. O. Southbrook, manager order and production department of the same firm. Their headquarters will be the home office of the company in Chicago.

* * *

Mr. W. J. Armstrong, manager of the Crushing and Pulverizing Sales Department of the Jeffrey Manufacturing Company, Columbus, Ohio, has recently received an appointment as Captain in the United States Army and assigned to the Ordnance Department in Washington, D. C.

The C. W. Hunt Company, Inc., New York City, has just published an illustrated bulletin, 18-2, describing storage battery industrial trucks, tractors and trailers. Not only are standard types of machines shown but several others equipped with side and end dumping bodies.

Mr. B. H. Tripp, special representative of the Chicago Pneumatic Tool Company on the Pacific Coast has succeeded Mr. M. W. Priseler as district manager of sales for the Pacific Coast territory. Mr. Tripp's headquarters are at 627 Howard Street, San Francisco. The Los Angeles branch of the company at 521 Title Insurance Building comes under Mr. Tripp's jurisdiction.

* * * *

Mr. C. E. Haygood, manager of the railway department of The Manila Electric Railroad and Light Company of Manila, Philippine Islands, is visiting the United States on a vacation and for the purpose of consulting with the officers of The J. G. White Management Corporation, New York, N. Y., the operating managers of the Manila Company. He expects to return to the Philippines some time before the first of the year.

The W. J. Crouch Company, Inc., and Rownson, Drew & Clydesdale, Inc., announce the amalgamation of their respective organizations. All business and manufacturing operations will in the future be conducted under the name of Rownson, Drew & Clydesdale, Inc., with general offices at 68 William Street, New York City. Mr. P. G. Donald, president of Rownson, Drew & Clydesdale, Inc., will continue in that office, while Mr. I. Smullyan, president of the W. J. Crouch Company, Inc., will be managing director of the new firm.

* * * *

The Chicago Pneumatic Tool Company announces that a contract has been let and work started on the erection of an addition to their Cleveland plant, which is planned to double the present output. It is expected that work will be completed on the building itself about November first. The necessary equipment has been ordered and it is believed will be delivered and ready for installation by the time the building is completed, so that the additional production contemplated will be available soon thereafter.

* * * *

The Austin Company, Cleveland, Ohio, has just taken off the press a 64-page catalog called "The Austin Book of Buildings." It is devoted to showing the Austin method of designing and erecting industrial buildings. There are some 50 illustrations of factory interiors and exteriors, showing how standardized construction is adapted to various conditions. Detailed drawings of cross sections, floor plans, side elevations, front elevations, etc., are given. There are also full specifications for each standard, the uses for each type of building and their adaptability to crane service and the like.

* * * *

The Oakley Chemical Company, New York City has developed a process for reclaiming cotton wastes and wiping cloths, which is completely described in a little booklet just off the press entitled "Oakite for Cleaning." Two methods are illustrated, one in which the waste or cloths are washed by a tank method, and the second where a laundry wheel is employed. It is claimed that Oakite cleans according to an entirely new principle, as it emulsifies the oils and greases and thus destroys their adhesive nature, therefore its action is a physical one instead of a chemical one as in the case of alkali cleaners which saponify.

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. The Explanatory Note is given in the Index Section of Industrial Management, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

Note.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Administration

Training in Industrial Administration (88888 B). W. G. Cass. 3000 w. Cas Eng Mthly—Aug., 1918. Reviews existing facilities for study along this line, and calls attention to a scheme proposed by Northumberland Miners' Assn.

Aircraft Plant

See Training, under Mechanical Engineering, *Aeronautics*.

Apprenticeship

Apprenticeship and the War (88890 B). E. T. Good. 1200 w. Cas Eng Mthly—Aug., 1918. Movements to provide assistance for discharged soldiers who desire professional and business appointments.

Boys

See same heading under Welfare and Safety.

Chemistry

Het onderwijs in de chemische technologie aan de Technische Hoogeschool (89054 B). A. Steger. Ills. 5200 w. Instruction in chemical technology at Dutch Technical High School.

The Removal of the German Camouflage from Chemistry (88951). Townes R. Leigh. 5000 w. Mfrs Rec—Sept. 19, 1918. Showing how little Germany has really accomplished in original research and chemical discoveries.

Disabled Men

The Vocational Re-education of Disabled Soldiers from the Mining Industry (88873 N). F. H. Sexton. 4800 w. Can Min Inst, Bul—Sept., 1918. Especially what is being done in Canada for men formerly employed in mining and metallurgical industries.

Electrical Employees

Methods of Education for Electrical Employees of Iron and Steel Mills (88913 N). 10 pp. Assn I S E E—Sept., 1918. Suggestions of the Educational Committee.

Employees

Responsibility of Employers to Their Employees in Patriotic and Educational Work (88950). 2000 w. Mfrs Rec—Sept. 19, 1918. Importance of educating the laboring people as to meaning of the war.

Executives

Training Minor Executives In a Large Shoe Factory (89096 A). Roy Willmarth Kelly. Ills. 3000 w. Ind Man—Oct., 1918. Methods in a New England factory to prepare employees for advancement.

Laboratory

National Physical Laboratory (89078). 2600 w. Times Engng Supp—Aug., 1918. Variety of work and results attained during the past year.

Mechanical

Experience in Training Mechanical Operators (88794 A). Ills. 1200 w. Iron Age—Sept. 5, 1918. Methods of developing efficient workers from unskilled men and women.

Mine Foremen

Practical Examination for Mine Foremen (88604 A). J. J. Bourxuin. 1400 w. Colly Gdn—Aug. 9, 1918. Methods used last May by the examining board at Bruceton, Pa.

Motion Pictures

The Motion Picture and Its Relation to Industrial Problems (89031 A). Ernest A. Dench. 3000 w. Am Mach—Sept. 26, 1918. Suggestions for instructing salesmen, solving efficiency problems and obtaining help by means of moving pictures.

Science and Industries

The Movement for Closer Application of Science to Industries (88691 A). A. Montgomery. Presidential address to Roy. Soc. of W. Aust. 5000 w. Aust Min Std—Aug. 1, 1918. Reviews steps taken in the British Empire to co-ordinate science and industry.

Valedictory Address by President of South African Institution of Engineers (88692 N). G. M. Clark. 7500 w. So Af Instn Engrs, Jl—July, 1918. The value of scientific knowledge in industry and related topics.

British Science In Industry (89074). 2000 w. Times Engng Supp—Aug., 1918. Account of technical exhibits shown at a recent exhibition organized by British Science Guild.

Shop Schools

Training Men and Boys in a Shop School (89035 A). A. N. Hook. 2000 w. Am Mach—Sept. 26, 1918. Successful methods.

Specialization

Specialization and Invention (88615 A). W. G. Cass. 1500 w. Engr—Aug. 2, 1918. Considers the relation between specialization and inventiveness.

Women Workers

Training the Women War Workers (88496 A). Edward K. Hammond. Ills. 1800 w. Machy—Sept., 1918. Methods used in plant of the Taft-Peirce Co. by means of a "Vestibule" school.

Woman Substation Operators a Notable Success (89006). Ills. 2000 w. Elec Wld—Sept. 21, 1918. Pioneer work by Boston Edison Co. in training women for electrical service positions yields admirable results.

To avoid error, please order by title and number only.

FINANCE AND COSTS

Accounting

Cost Accounting to Aid Production—I (89086 A). G. Charter Harrison. 10000 w. Ind Man—Oct., 1918. How the principles of industrial management may be applied to a manufacturing system.

The Inadequacy of Present Depreciation Accounts (88943). Owen Ely. 4000 w. Ry Age—Sept. 20, 1918. Proper accounting methods essential during Government operation. Effect of rules now in force.

Canada

Le Commerce Canadian Après La Guerre (89065 B). L. Lorrain. 3100 w. Rev Trimestrielle Canadienne—Aug., 1918. Considerations on Canadian trade and industry after the war.

Compensation

Forms for Use in Recording Compensation (88790). 2200 w. Cl Age—Sept. 12, 1918. How to keep records to stimulate the work of safety.

Compensation Contract

Director General Approves Compensation Contract (88641). 13000 w. Ry Age—Sept. 6, 1918. Statement outlining the scope of the contract, and reason for rejecting certain requests for modifications.

Railway Executives Advisory Committee to Report (88814). Also editorial. 5000 w. Ry Age—Sept. 13, 1918. Recommends the acceptance of the contract as finally approved by Director General McAdoo.

Cost-Plus

Hardships of the Cost-Plus Plan (89097 A). J. P. Brophy. 1000 w. Ind Man—Oct., 1918. Difficulties and disadvantages for manufacturers of machinery.

Cost Sheet

A Uniform Cost Sheet (89021). 2500 w. Cl Age—Sept. 19, 1918. Substance of a report on the question of a standard cost sheet.

Currency

Note Issues and Currency (88893 N) Alex. Aiken, with discussion. 7500 w. So Af Instn Engrs. Jl—Aug., 1918. Outlines a theory of value. The stable value of gold explained, and related topics.

Depreciation

Some Pitfalls in Regulating Depreciation (88350). John Bauer. 3000 w. Elec Ry Jl—Aug. 24, 1918. How deduction of depreciation is determined.

Engineering

The Financial Aspect of Engineering (88889 B). Percy F. Martin. 4000 w. Cas Eng Mthly—Aug., 1918. Discussed from a British viewpoint.

Foreign Markets

Testing the Buying Power of a Foreign market (89040 A). L. W. Schmidt. 4000 w. Am Mach—Sept. 26, 1918. Suggestions for estimating probable markets in foreign countries.

German Industries

L'Industrie Allemande Et L'Après-Guerre (89063 C + D). Jaurégy, Froment and Stephen. 9500 w. Bul Soc D'Encouragement pour L'Industrie Nationale—May-June, 1918. Economic condition of industrial Germany after the war.

Gold

Need of Sustaining Gold Production (88777). Courtenay De Kalb. 2800 w. Mfrs Rec—Sept. 12, 1918. Need of action by the Government and explaining the plight of the industry.

Purchasing

Collective Selling Is Declared Necessary (88795 A). 3000 w. Iron Age—Sept. 5, 1918. Reviews an important report by Pierce C. Williams on the reconstruction of France. French manufacturers will place orders through a central purchasing agent assisted by French credit.

Hints on Purchasing (88724 A). Frank T. Arms. 3000 w. U S Nav Inst, Pro—Aug., 1918. Outlines fundamental principles of system applied to U. S. Navy.

The Market Gage Dollar (88728 N). D. J. Tinnes. 2000 w. Am Ec Rev—Sept., 1918. Statement of the Market Gage plan for stabilizing the purchasing power.

Statistics

Relation of Statistics and Accounts in Industrial Management (89095 A). Milton B. Ignatius. 4000 w. Ind Man—Oct., 1918. Need of much wider use of statistics, giving suggestions for statistical study and points in regard to the work.

Trade

Brazilian Trade Conditions (88898). 1200 w. Naut Gaz—Sept. 14, 1918. The effects of the war upon trade and finance.

France's Rehabilitation (88653). 1500 w. Naut Gaz—Sept. 7, 1918. Central buying and collective selling to be the rule.

Germany's Trade Relations with the Near East (88652). 1800 w. Naut Gaz—Sept. 7, 1918. Commercial conquest planned of the Balkan States and Turkey.

Valuation

Commerce Commission Makes First Final Valuation Report in Texas Midland Case (88780 A). 2500 w. Eng News-Rec—Sept. 12, 1918. No single sum is indicated as final value. Depreciation, etc.

Interstate Commerce Report on Texas Midland Valuation (88669). 4000 w. Ry Rev—Sept. 7, 1918. Portion of the report dealing with the protests of the carrier are summarized.

Wages

Wage Increase for Agents, Clerks, and Laborers (88642). 4500 w. Ry Age—Sept. 6, 1918. Railroad wages amounting to $25 a month raises for million employees.

War Finance

Substance and Shadow in War Finance (88727 N). Carl C. Plehn. 15 pp. Am Ec Rev—Sept., 1918. Considers real costs versus money costs, a measure of real costs, inflation, loans versus taxes, etc.

MANAGEMENT

Character

Character Analysis (89134 A). 500 w. Ind Man—Oct., 1918. Editorial on the art of character analysis and referring to George K. Parson's views.

Committees

Workshop Committees (88885 B). 2500 w. Cas Eng Mthly—Aug., 1918. Their functions, importance, and influence.

Control

Graphic Production Control—II (89088 A). C. E. Knoeppel. 4500 w. Ind Man—Oct., 1918. Fifteen laws of control explained.

Efficiency

Efficiency — Stop! Look! Listen! (89092 A). V. J. Loomis. 500 w. Ind Man—Oct., 1918. A reply to W. H. Smyth's article in the September issue.

Employees

Putting Round Pegs in Round Holes (89099 A). George Kingdon Parsons. 1700 w. Ind Man—Oct., 1918. Value of character estimates in choosing employees.

Employment

Progress of Employment Management (89137 A). 300 w. Ind Man—Oct., 1918. Short editorial on its rapid growth.

Engineers

After Four Years of War (89067). 3200 w. Times Engng Supp—Aug., 1918. The engineer's part in the great struggle from the industrial viewpoint.

Engineering Relationships (89135 A). 600 w. Ind Man—Oct., 1918. Editorial on progress and development in the engineering profession.

German Industries

L'Industrie Allemande Et La Guerre (89062 C + D). Jauréguy, Froment and Stephen. 25000 w. Bul Soc D'Encouragement pour L'Industrie Nationale—May-June, 1918. The great industries in war time; nitrogen, sulphur, sulphuric acid, fuels, base and precious metals, alcohol, greases, soaps and glycerins, wood, etc.

Housing

Planning a Housing Development for an Industrial Plant (89087 A). Benjamin Wilk. 1000 w. Ind Man—Oct., 1918. Suggestions for determining housing needs of workers.

India

Industrial Development in India During the War (89029 A). D. T. Chadwick. 2000 w. Roy Soc Arts, Jl—Sept. 6, 1918. Serial, 1st part. New factories, organization of resources, search of local resources for substitutes, etc.

Inspection

Inspection and Quality Control (89093 A). F. E. Merriam. Ills. 5600 w. Ind Man—Oct., 1918. Outlines the organization of an inspection department for manufactured products, the training of inspectors, and the use of inspecting gages.

Labor

Why Do Valuable Men Leave? (89138 A). Russell Waldo. 600 w. Ind Man—Oct., 1918. Some of the causes. Value of old employees.

Labor Problems

How a Medium-Sized Plant Solves Its Labor Problems (88495 A). H. E. Sloan. 1000 w. Machy—Sept., 1918. Underlying principles in the management of the Cushman Chuck Co.

Labor Shortage

Labor Shortage Made Good by Station Contract System (88960 A). F. P. Kemon. Ills. 1600 w. Eng News-Rec—Sept. 19, 1918. Account of methods used on the Winnipeg aqueduct and results.

Labor Turnovers

Keeping Track of Labor Turnover (88808). E. H. Fish. 1600 w. Auto Ind—Sept. 12, 1918. Value of carefully compiled turnover records.

Organization

Contract Organization Vitally Important for War Work (88958 A). Francis Donaldson. 3500 w. Eng News-Rec—Sept. 19, 1918. Careful co-ordination of forces needed. Charts show typical contracts.

Output

A Method of Regulating Shop Output (88690 A). E. T. Spidy. 2000 w. Ry Mech Engr—Sept., 1918. Explains a graphical method and its advantages.

Power

Mastering Power Production—IX (89098 A). Walter N. Polakov. 9 pp. Ind Man—Oct., 1918. Methods of determining standard power costs.

Public Utilities

Present War Production Made Possible by Utilities (89005). Ills. 2000 w. Elec Wld—Sept. 21, 1918. The aid public utilities have given to production for war.

Salvage

Salvage Department of the Westinghouse Lamp Company (89094 A). A. W. Ross. Ills. 400 w. Ind Man—Oct., 1918. Report of the work.

Soldiers

Opportunities for Returning Soldiers (88630 A). 2500 w. Am Mach—Sept. 5, 1918. Plan suggested by Secretary Lane for dealing with home coming soldiers.

Time Studies

Time Studies for Rate Setting on Gisholt Boring Mills—IV (89089 A). Dwight V. Merrick. 10 pp. Ind Man—Oct., 1918. Tables are given and details of machine manipulation.

Trucking

Need for Organized Trucking (89109 A). W. C. Nisbet. 2500 w. Ind Man—Oct., 1918. Suggestions for improving present conditions.

War Work

Back Up Your Boys in France (89136 A). 300 w. Ind Man—Oct., 1918. Short editorial on the possibilities for service.

Women Workers

Wartime Experience With Women in the Metal Trades (89018). 1200 w. Open Shop Rev—Sept., 1918. Their efficiency in machine shop work demonstrated.

Workmanship

Workmanship and Efficiency—Discussion (89090 A). A. R. Allard. 1500 w. Ind Man—Oct., 1918. Critical discussion of views in C. W. Starker's article in the July issue.

REGULATION

Control Order

The Converter Plant Control Order, 1918, and Its Relation to Colliery Electrical Installations (88859 A). L. Fokes. 2200 w. Ir & Cl Trds Rev—Aug. 16, 1918. Aims to obtain the maximum useful energy from every pound of coal.

Labor

Labor's Disloyal Minority (89017). Charles L. Underhill. 12 pp. Open Shop Rev—Sept., 1918. A speech before the Mass. Constitutional Convention in opposition to a proposed amendment which would deprive the courts of power to issue injunctions in labor disputes.

Recent Developments in the British Labor Movement (88726 N). G. D. H. Cole. 20 pp. Am Ec Rev—Sept., 1918. Explains the character of British trade unionism and discusses prospects that will follow the return of peace.

The Problem of Industrial Unrest (88715 A). A. J. Butler. 2500 w. Aust Min Std—July 18, 1918. On conditions in Australia.

The Problem of Industrial Unrest (88793 A). Meredith Atkinson. 1500 w. Aust Min Std—July 25, 1918. Relation between economics and ethics.

Labor Problem

Labor and Capital (88826 A). Harry Tipper. 1800 w. E Cb Phila, Jl—Sept., 1918. History of the labor problem; ideals of labor and capital; political, industrial and social aspects of the problem.

Law

See same heading under Welfare and Safety.

Legislation

Legislation for Engineers (88663). Frederick H. Peters. Read before Engng. Inst. of Canada. 3000 w. Can Engr—Sept. 5, 1918. Considered with reference to Canada.

Organization

Shop Organization: A Simple Scheme (88823). W. E. John, with discussion. Read before Aeronautical Soc. 6000 w. A A Wkly—Sept. 16, 1918. Outlines a scheme for the organization of a factory.

Power

See same heading under Management.

Power Law

Dr. H. A. Garfield for $200,000,000 Power Law (89009). 3000 w. Elec Wld—Sept. 21, 1918. Urges the importance of passing the emergency war plant act to provide adequate power supply for coal production.

Rate Regulation

Cost of Service the Chief Factor in Rate Regulation (88576 A). William G. Raymond. 3000 w. Eng News-Rec—Sept. 5, 1918. Explains method believed to be in accord with court decisions.

WELFARE AND SAFETY

Accident Prevention

Progress in Accident Prevention (88786). 2500 w. Cl Age—Sept. 12, 1918. What the National Safety Council has accomplished.

Boys

The Boy in Industry—A British Effort to Protect Him (89139 A). Robert R. Hyde. 400 w. Ind Man—Oct., 1918. Qualities needed for successful leadership in boy welfare work.

Dust

The Effects of Dust Inhalation (88504 N). J. S. Haldane. 4500 w. Chem, Met & Min Soc S Af, Jl—July, 1918. Results of investigations on the effects of inhaling different kinds of dust, and on conditions for neutralizing the ill effects.

Mortality from Respiratory Diseases in Dusty Trades (88870 N). Frederick L. Hoffman. 433 pp. U S Dept Labor, No. 231—June, 1918. Deals particularly with inorganic dusts.

The Effects of Dust Inhalation (88882 N). John Scott Haldane, with discussion. 30 pp. Instn Min Engrs, Trans—Aug.-Sept., 1918. Practical information based on investigations.

Explosives

Safety in the Use of Explosives (88787). Arthur La Motte. 2500 w. Cl Age—Sept. 12, 1918. Development of measures and appliances for avoiding accidents. List of "don'ts."

Goggles

Goggles More Than Protective (88677 A). W. T. Power. 1800 w. Ry & Loc Eng—Sept., 1918. The value to industrial workers when properly fitted.

Housing

See same heading under Management.

Law

Abnormal Movement of Machinery (89039 A). Chesla C. Sherlock. 4000 w. Am Mach—Sept. 26, 1918. Résumé of laws in regard to injuries caused by the accidental starting of machinery.

Metallurgical Plants

Safety and Health in Hydrometallurgical Plants (88798 A). A. W. Allen. 1800 w. Eng & Min Jl—Sept. 14, 1918. Emphasizes the importance of exercising care in design and of considering the operator of the plant.

Mine Accidents

Who Gets Hurt and When? (88785). 1200 w. Cl Age—Sept. 12, 1918. Details in regard to the distribution of mine accidents. Points of greatest accident hazard indicated.

Public Health

Public Health and Engineers (89068). 2000 w. Times Engng Supp—Aug., 1918. Need of team work for accomplishing results.

Safety Appliances

Mine Safety Appliances in Warfare (88789). F. H. Trego. 1800 w. Cl Age—Sept. 12, 1918. Importance of conserving human life. Use of Gibbs self-contained breathing apparatus.

MECHANICAL ENGINEERING

AERONAUTICS

Aerial Mail

The Dispatch Board Invented by Captain Benjamin B. Lipsner, Chief of the Aerial Mail Division, Post Office (88658). Ills. 700 w. A A Wkly—Sept. 9, 1918. Detailed description.

Aerial Photography

Making War Maps by Camera (88981). Ills. 700 w. Auto Ind—Sept. 19, 1918. Aerial photography in military operations.

Aeronautic Problems

Some Outstanding Problems in Aeronautics (88514). W. F. Durand. 4000 w. Auto Ind—Aug. 29, 1918. Serial, 1st part. Sixth Wilbur Wright lecture in London. Problems of material, size limits, variable wiring area and camber.

Aircraft Investigation

Offered Aid of Allies Not Accepted by Aircraft Authorities (88807). Allen Sinsheimer. 1800 w. Auto Ind—Sept. 12, 1918. Suggested subjects for a real aircraft investigation.

Complete Text of Senate Aircraft Report (88515). 7 pp. Auto Ind—Aug. 29, 1918. Text of report of the sub-committee on Military Affairs, appointed to investigate aircraft invention in the United States.

Airplane Delays

Airplane Delays Due to Lack of Co-operation and Experience (88510). David Beecroft. 4000 w. Auto Ind—Aug. 29, 1918. Explains reasons for delay.

Aviation

Italian War Aviation (88539). Giuseppe Bevione. Ills. 1500 w. A A Wkly—Sept. 2, 1918. Urging assistance in materials from America.

Biplanes

The Fokker Biplane (88966). G. Douglas Wardrop. Ills. 1700 w. A A Wkly—Sept. 23, 1918. Fokker biplane of the D VII type shown at the London Enemy Aircraft Exhibit.

Bombing Planes

Delay in Bombing Planes for War Program (88694). 3000 w. Auto Ind—Sept. 5, 1918. Story of failure of Bristol fighter.

De Haviland

The De Haviland V. Single Seater (88967). Ills. 1200 w. A A Wkly—Sept. 23, 1918. Description from a technical German aero paper.

Engines

The 180 Hp. Mercedes Aircraft Engine (88810). Ills. 2500 w. Auto Ind—Sept. 12, 1918. A development of the 160-hp. model having the same cylinder dimensions. Many details redesigned. Tests.

The 300 Horse-Power Maybach Aero-Engine (89045 A). Ills. 2500 w. Engr—Aug. 30, 1918. Serial, 1st part. Information and particulars concerning this new design.

The 240 H. P. 8-Cylinder Mercedes (88538). Ills. 1000 w. A A Wkly—Sept. 2, 1918. Serial, 1st part. Detailed report on the design of this engine based on an investigation of the engine taken from the German two-seater Albatros biplane.

High Altitudes

Problems in Flying at High Altitudes (88579 A). Augustus Post. 1000 w. Flying—Sept., 1918. Change in conditions due to reduced air pressure, influence on the aviator, etc.

Meteorology

Some Meteorological Conditions Which Increase the Danger of Flying (88824). C. J. P. Cave. Read before Aeronautical Soc. Ills. 3000 w. A A Wkly—Sept. 16, 1918. Serial, 1st part. Discusses gales, squalls; bumps and eddies; clouds, rain, hail and snow; fog and lightning.

Scout

Details of the Pfalz Single-Seater (88695). Ills. 1400 w. Auto Ind—Sept. 5, 1918. Serial, 1st part. Performance.

Training

Intensive Training in An Aircraft Plant (88512). Frank L. Glynn. Ills. 1000 w. Auto Ind—Aug. 29, 1918. Instruction at Curtiss Company's school.

AUTOMOBILES

Bodies

The Shell Body (88837 A). Eric W. Walford. Ills. 1000 w. Autocar—Aug. 17, 1918. Low weight and ample luggage carrying capacity two features. Its advantages.

Douglas Car

The Post-War Douglas Light Car (88590 A). Ills. 1000 w. Autocar—Aug. 10, 1918. Details of design. A striking departure in the suspension system.

Engine Design

Nomography in Engine Design (88572 B). F. Leigh Martineau. Charts. 4000 w. S A E, Jl—Sept., 1918. Read before Instn. Auto. Engrs, London. Graphic presentation of formulæ.

Engines

Oil-Burning Tractor Engines (88571 B). H. T. Sward, with discussion. 3000 w. S A E, Jl—Sept., 1918. The requirements, fuel, etc.

Tests of a Sleeve Valve Engine (88983). Ills 2000 w Auto Ind—Sept. 19, 1918. Characteristics of the engine of the American Sleeve Valve Motor Corp.

Gear Shift

A Mechanism for Changing Gears Automatically (88696). Ills. 1200 w. Auto Ind—Sept. 5, 1918. Gears shifted and clutch operated by engine power.

Headlights

Automobile Headlights and Glare-reducing Devices (88681 A). L. C. Porter. Ills. 2200 w. Gen Elec Rev—Sept., 1918. Methods in common use; and correct use.

Senate Report

Automobile Industry Unjustly Censured in Senate Report (88511). J. Edward Schipper. 1800 w. Auto Ind—Aug. 29, 1918. Cause of slow production explained.

Steam Motor

A New Coke Fuel Steam Motor (88616 A). Ills. 1500 w. Engr—Aug. 2, 1918. Details of design of an engine for a mechanically-propelling road vehicle.

New Steam Motor (89076). 1200 w. Times Engng Supp—Aug., 1918. New truck motor, a British design, using coke fuel for making steam.

Tractors

The Nuttall Tractor Transmission (88985). Ills. 1000 w. Auto Ind—Sept. 19, 1918. May be adapted to different designs of tractors.

The Peoria Kerosene Tractor (88513). Ills. 1500 w. Auto Ind—Aug. 29, 1918. Detailed description.

Trucking

Cleveland Truck Company Delivers Steel, Meat, and Groceries When Railroads Fail (88548 A). Ills. 2500 w. Com Vhle—Sept. 1, 1918. Work of the Highways Motor Transport Co.

Mine Quantity Production Made Possible by California Motor Trucks (88547 A). John Grant. Ills. 3000 w. Com Vhle—Sept. 1, 1918. Details of work accomplished by motor trucks.

Seven Trucks Replace Seventeen Horses Hauling Express Matter from Newark to New York (88550 A). Ills. 1500 w. Com Vhle—Sept. 1, 1918. Work of Leuddeke's Express Co. on 12-mile haul.

See also same heading under INDUSTRIAL MANAGEMENT, *Management.*

Truck Wheels

Making Cast Steel Wheels for U. S. Army Trucks (88564). Ills. 3500 w. Fndry—Sept., 1918. How increased output was met by the Dayton Steel Foundry Co.

COMBUSTION MOTORS

Diesel Engine

The Diesel Engine; Its Fuels and Its Uses (89105 A). Herbert Haas. Ills. 122 pp. U S Bur Mines—Bul 156. Discusses recent developments in the design and construction, the fuels suitable for burning in it, and its special uses.

Oil Engines

Heavy Oil Engine Developed in Europe (88830). Ills. 1500 w. Mar Eng, Can—Aug., 1918. A marine engine known as the Kromhout. Automatic starting, stopping, and reversing.

HEATING AND COOLING

Central Heating

Inorichtingen voor Centrale verwarming, warmwatervoorziening en Stoomlevering (89050 B). J. Mantel. Ills. 3200 w. Ingenieur—July 6, 1918. Central heating, warm water and steam supply at a large insane asylum at Woensel, Holland.

Coal Requirements

Coal Required for Heating (88487). William Ehrlich. 2000 w. Pwr Pt Eng—Sept. 1, 1918. Methods of predetermining coal requirements based on the average temperatures and modern equipment.

Combustion

Burning Bituminous Coal in House-Heating Boilers (88969). W. A. Pittsford. Ills. 1600 w. Ht & Vt Mag—Sept., 1918. From address before Smoke Prevention Assn. The mixing of oxygen with the combustible the important factor.

Equipment

Care of Heating and Ventilating Equipment (88672). Harold L. Alt. 1200 w. Power—Sept. 10, 1918. Serial, 1st part. On the economical operation,

Evaporation

A New System of Regenerative Evaporation (88557 A). William L. De Baufre. Ills. 3000 w. A S M E, Jl—Sept., 1918. Brief description of the system with tests.

Fuel Conservation

Burning Soft Coal in Heaters Designed for Hard Coal (88968). 1100 w. Ht & Vt Mag—Sept., 1918. Suggestions prepared by William H. Reid for selecting and using coal for house heating equipment.

High Temperatures

High Temperature Processes and Products. (88903 A). Charles R. Darling. Cantor lecture. Ills. 4000 w. Roy Soc Arts, Jl—Aug. 23, 1918. Serial, 1st part. Conditions affecting the production of high temperatures, and successful methods of practical utility and their uses.

Ice Plant

Modern Stationary Can Raw Water Ice Plant (88685 A). Ills. 4000 w. Ice & Refrig—Sept., 1918. Details of plans and equipment of a plant at Canton, Ohio.

Refrigerating Machines

Multiple Effect Compression Ice-Making and Refrigerating Machines (88865 A). Ills. 1000 w. Engng—Aug. 23, 1918. A type of CO_2 refrigerating machines which differs from the ordinary compression machine.

Refrigeration

Refrigerating Economies (88491). Peter Neff. 1700 w. Pwr Pt Eng—Sept. 1, 1918. How to locate and stop losses in compressor room, pipe lines, and cooling rooms.

Temperature Regulating

Care of Pneumatic Temperature Regulation Systems (88581). 1800 w. Power—Sept. 3, 1918. General suggestions.

HYDRAULIC MACHINERY

Pumps

Points in Pump Selection (89027). B. N. Everett. 1200 w. Power—Sept. 24, 1918. Calls attention to certain points.

MACHINE ELEMENTS AND DESIGN

Bearings

White Brass Bearing Metals as a Substitute for High-Grade Babbitt (88749 A). L. D. Staplin. 1000 w. Am Mach—Sept. 12, 1918. Methods followed in using white brass as a bearing metal.

Drafting

Simple Drafting Room Methods (89091 A). G. F. Hamilton. 1500 w. Ind Man —Oct., 1918. System of a machine-building plant for recording drawings, etc.

Gages

See same heading under Measurement.

Screw Threads

The Relation of Screw-Thread Angles to Other Functions (89037 A). H. J. Bingham Powell. 1200 w. Am Mach—Sept. 26, 1918. Arguments in favor of the adoption of an international screw thread.

Springs

Helical Springs (88601 A). M. H. Sabine. Ills. 600 w. Mech Wld—Aug. 2, 1918. A graphical method of giving requisite information for drawing-office use.

MACHINE WORKS AND FOUNDRIES

British Foundries

British Foundrymen Discuss Weighty Problems (88565). Ills. 2500 w. Fndry —Sept., 1918. After-war conditions discussed by president Thomas H. Firth.

Cable Winding

Automatic Cable Winding Mechanism (88501 A). Donald A. Baker. Ills. 1500 w. Machy—Sept., 1918. Arrangement for winding cable used in making lead balls for shrapnel shells.

Casehardening

Testing the Relative Merits of Case Hardening Materials (89036 A). Charles N. Underwood. Ills. 1000 w. Am Mach —Sept. 26, 1918. Methods used in Remington Typewriter Works to determine qualities.

Castings

How One Steel Foundry Met the Need for Ship and Railway Castings (88568). H. Cole Estep. Ills. 3000 w. Fndry—Sept., 1918. Work at Birdsboro, Pa.

The Deformation of Steel Castings (88567). T. Brown. From paper before British Fndman's Association. 3500 w. Fndry—Sept., 1918. Deformities and their causes and prevention.

Cast Iron

The Fluidity of Molten Cast Iron (88566). Matthew Riddell. From paper before British Fndman's Association. 3500 w. Fndry—Sept., 1918. Fluidity depends on the amount of superheat that has been imparted to it in the cupola.

Cores

Accuracy in Setting Cores (88634 A). J. V. Hunter. Ills. 1000 w. Am Mach—Sept. 5, 1918. A method of supporting larges cores accurately from body of flask.

Die Castings

The Design of Die Castings (89030 A). M. Stern. Ills. 1500 w. Am Mach—Sept. 26, 1918. Some of the features of design.

Dies

Bulldozer Operations With One- and Two-Motion Dies (88747 A). J. V. Hunter. Ils. 4000 w. Am Mach—Sept. 12, 1918. Showing how a variety of work, including pipe bending, with one, two or more stage dies on a bulldozer.

Construction and Operation of Temporary Dies (88751 A). Hugo F. Pusep. Ills. 1200 w. Am Mach—Sept. 12, 1918. How they may be made and used when only a few parts of a given kind are wanted.

Dies for Tape-Measure Winder (88502 A). Ills. 1500 w. Machy—Sept., 1918. Set of dies for performing sequence of operations under power press.

Double-Movement Dies for Bulldozer Work (88938 A). J. V. Hunter. Ills. 1000 w. Am Mach—Sept. 19, 1918. How the bulldozer may be used over a wide range of operations with the aid of easily made dies.

Drafting

Organization and Wage Payment for the Drafting Department (89032 A). J. B. Conway. 2000 w. Am Mach—Sept. 26, 1918. System designed to effect maximum results.

Drawings

Drawing-Room System in the Engineering Department (88750 A). G. F. Hamilton. Ills. 700 w. Am Mach—Sept. 12, 1918. Outlines methods used in the drafting room of the Goulds Manufacturing Co.

Forgings

Heat Treatment of Large Forgings: Methods and Apparatus (88829). H. H. Ashdown. Read before Inst. Mech. Engrs. Ills. 3500 w. Mar Eng, Can—Aug., 1918. Methods in use and their effects on the quality of the steel treated.

Furnaces

Automatic Shell Heat Treating Furnaces (88796 A). W. J. Harris, Jr. Ills. 1800 w. Iron Age—Sept. 5, 1918. Describes mechanical devices used in a new gas-fired installation at Pawtucket, R. I.

Fuse

Making the Mark III Detonating Fuse (88497 A). Edward K. Hammond. Ills. 4000 w. Machy—Sept., 1918. Serial, 1st part. An important phase in the manufacture of munitions.

Gages

Gage Making in a Shell Plant (88492 A). Franklin D. Jones. Ills. 3500 w. Machy—Sept., 1918. Sixth of a series of articles describing methods in a plant making the U. S. 75 MM. shell. Features in making working and inspection gages.

Gears

Heat-Treating Gears for Army Trucks in the Electric Furnace (88746 A). Dwight D. Miller. 3500 w. Am Mach—Sept. 12, 1918. Very satisfactory results.

Grinding

Grinding Relief of Milling Cutters (88494 A). Ills. 1200 w. Machy—Sept., 1918. Comparison of use of disk wheels and cup-wheels and analysis of results.

Helmets

Ancient Helmet Making (88937 A). H. H. Manchester. Ills. 2500 w. Am Mach—Sept. 19, 1918. Describes helmets used from 2920 B. C. to the present time.

Jigs

Drilling Jigs Used in the Manufacture of Hosiery Machines (89034 A). Robert Mawson. Ills. 900 w. Am Mach—Sept. 26, 1918. Jigs used in making the Banner knitting machines.

Lathes

Lathes for the Present Gun Program (88752 A). A. L. DeLeeuw. Ills. 2000 w. Am Mach—Sept. 12, 1918. Suggestions for securing a sufficient number of lathes and other machine tools.

Machining

Machining Pistons, Flywheels, and Cylinders of Gasoline Engines (88635 A). M. E. Hoag. Ills. 1000 w. Am Mach—Sept. 5, 1918. How automatics are used in the production of machine parts.

Metal Beds

The Manufacture of Metal Beds (88631 A). Frank A. Stanley. Ills. 2500 w. Am Mach—Sept. 5, 1918. Methods used in pouring great numbers of cast-iron joints.

Milling Practice

Milling Practice in Railway Shops (88689 A). Frank A. Stanley. Ills. 2000 w. Ry Mech Engr—Sept., 1918. Examples of cutters used with success in Sacramento shops.

Nut Forging

Hollings Indenting Type of Nut-Forging Machines (88498 A). Ills. 1500 w. Machy—Sept., 1918. Machine for making well-formed blanks, with a relative small amount of scrap.

Patterns

The Pattern for a Wyper Shaft Bracket (88863 A). James Edgar. Ills. 1200 w. Mech Wld—Aug. 16, 1918. Directions for rather difficult work.

Accurate Setting of Patterns for Plate-molding Machines (88843 A). Ills. 700 w. Mech Wld—July 12, 1918. Gives a method of accurately laying off the patterns and fastening them to the plates.

Planers

Metal-Planing Machines of Concrete (89075). 1000 w. Times Engng Supp—Aug., 1918. Large planing machine built of concrete for constructing gun-boring machines.

Shafts

Critical Speed in Tapered Shaft Design (88503 A). Alfred Musso. 1000 w. Machy—Sept., 1918. Derivation of formulæ and examples illustrating their use.

Shells

Making the U. S. 8-in. Shell (88745 A). M. E. Hoag. Ills. 2000 w. Am Mach—Sept. 12, 1918. Serial, 1st part. Shows practice in shops of the Root & Vandervoort Eng. Co. of Moline, Ill.

Shop Practice

Modern Workshop Practice (88834 N). W. Wilson. Ills. 5000 w. Comwh Engr—Aug., 1918. Serial, 1st part. The science of quick repetition. A New Zealander's experience in British shops.

Steel Cables

The Manufacture and Testing of Cast Steel Chain Cables (88850 A). 3000 w. Engr—Aug. 16, 1918. Memorandum issued by Lloyd's Register of Shipping.

Taps and Dies

Taps and Dies for Production Work (88853 A). G. Doorakkers. Ills. 2000 w. Engr—Aug. 23, 1918. Serial, 1st part. Details of work, and examples.

Tool Lubrication

Emulsion Lubrication of Cutting Tools (88632 A). J. A. De Cew. 1300 w. Am Mach—Sept. 5, 1918. Problems of tool lubrication and how emulsifying agents are used.

Welding

Metallic Electrode Arc Welds (88540 A). O. S. Eschholz. Ills. 2000 w. Weld Engr—Aug., 1918. Suggestions for determining the quality of the joint.

Selection and Application of Electric Arc Welding Apparatus (89012 A). A. M. Candy. Ills. 5000 w. Elec Jl—Sept., 1918. Chief requisites for electric arc welding, discussing the electrical equipment and its application.

The Welding of Iron and Steel (88869 N). W. H. Cathcart, with discussion. Ills. 25 pp. West Scot I & S Inst, Jl—April, 1918. Welding as carried on at the smith's fire and the forge furnace.

Welding a Large Alligator Shear Frame (88627). J. H. Rodgers. Ills. 1000 w. Pwr House—Aug., 1918. Interesting repair by the thermist welding process.

Westinghouse Plant

The New Westinghouse Plant (88485). Ills. 2500 w. Pwr Pt Eng—Sept. 1, 1918. Details of Essington works, near Philadelphia. Employs both isolated plant and central station service.

Wigglers

Wigglers and Their Uses (89033 A). Hugo F. Pusep. Ills. 1200 w. Am Mach—Sept. 26, 1918. Uses to which wigglers may be applied for much work usually performed by use of buttons.

MATERIALS OF CONSTRUCTION

Alloys

Industrial Processes for the Speedy Analysis of Alloys (88716 A). James R. Downie. 4000 w. Aust Min Std—July 18, 1918. On processes suitable for the works analyses of alloys.

Cast Iron

The Addition of Steel to Cast Iron (88613 A). J. E. Hurst. 1500 w. Engr—Aug. 2, 1918. On the use of steel scrap in pig iron mixtures melted in the cupola.

Cotton

The Work of the Imperial Institute in Connection with British Cotton Cultivation (89001 N). 10 pp. Imp Inst, Bul—Jan.-March, 1918. Information on aspects of cotton production, with list of special reports and articles bearing on the subject.

Iron Alloys

Tantiron (88610 A). Ills. 2500 w. Engng—Aug. 9, 1918. The manufacture and qualities of this acid-resisting material.

Iron Protection

Standards for Protective Finishes for Iron (88569). E. P. Later. 3500 w. Fndry—Sept., 1918. Results of tests which indicate the protective qualities of various metals and thicknesses of coatings.

Refractories

Refractories from the Scientific Standpoint (88954). Charles Catlett. 1000 w. Mfrs Rec—Sept. 19, 1918. Value of these materials.

Steel

Tensile Strength and Hardness of Steel (88754 A). H. M. Brayton. 1000 w. Iron Age—Sept. 12, 1918. Their relation shown by means of graphical charts.

Substitutes

Substitutes in Germany (88842 A). 2500 w. Eng Rev—Aug., 1918. Serial, 1st part. Shows the difficulties under which the enemy is laboring in industry, from the lack of raw materials.

Waste

The Utilization of Waste Products (88791 A). 2200 w. Aust Min Std—July 18, 1918. Serial, 1st part. Detinning of waste tin plate, or recovery of tin from tin plate scrap in present number.

Wool

The Australian Wool Industry (88792 A). 1500 w. Aust Min Std—July 18, 1918. Serial, 1st part. The knitting trade in New South Wales.

MEASUREMENT

Bolts

Stresses in Bolts in Fulcrum Brackets (88996 A). V. M. Summa. Ills. 800 w. Mech Wld—Aug. 30, 1918. Serial, 1st part. General principles involved in the design with analysis of typical cases.

Calorimeters

Some Points Regarding Calorimeter Efficiency (88901 B). Walter P. White. 2500 w. Fkn Inst, Jl—Sept., 1918. Considers sources of calorimetric error and the advantages of different types of instrument.

Chains

Safe Chain Loads (88499 A). A. Black. 2500 w. Machy—Sept., 1918. Factors that determine safe loads, and effects by annealing chain.

Dynamometers

A 000 Hp. Dynamometer Installation (88809). Ills. 1000 w. Auto Ind—Sept. 12, 1918. Features of interest in the new test house of the Duesenberg Motors Corp.

Gages

Rules for Computing Gage Tolerances (89108 A). D. Douglas Demarest. Ills. 1500 w. Ind Man—Oct., 1918. Simple rules for calculating the tolerance of limit gages, with comments on gage design.

Gas Temperatures

Measuring the Temperature of Gases in Boiler Settings (88712). Henry Kreisinger and J. F. Barkley. 60 pp. U S Bur Mines—Bul 145. Information as to the accuracy of temperature measurements made under certain conditions and the corrections that can be safely applied.

Indicator Diagrams

The Theoretical Indicator Diagram (88984). O. A. Malychevitch. 2500 w. Auto Ind—Sept. 19, 1918. Serial, 1st part. Method of predetermining the gas temperatures and pressures for various points in the engine cycles of the charge and the physical properties of the components.

Pyrometers

Pyrometers, Their Construction and Repair (88748 A). J. A. Lucas. Ills. 3000 w. Am Mach—Sept., 1918. Manufacture and upkeep of a number of types.

Pyrometry

Pyrometers and Pyrometry (88997 N). Ills. 168 pp. Faraday Soc, Trans—June, 1918. General discussion; bibliography.

Rotating Discs

The Strength of Rotating Discs (88607 A). H. Haerle. 3500 w. Engng—Aug. 9, 1918. Describes a method of ascertaining the distribution and magnitude of stresses which can be applied to any profile, and gives a chart for reducing the mathematical work to a minimum.

Safety Valves

Graphic Method of Determining Size of Safety Valve (88833). H. F. Gauss. Chart. 1500 w. Power—Sept. 17, 1918. Reasons for increasing maximum allowable lifts above those permitted in the A. S. M. E. Code. General solution.

Weights and Measures

Report of the Committee on Weights and Measures of the American Society of Mechanical Engineers (88558 A). 10 pp. A S M E, Jl—Sept., 1918. Abstract of a report by F. A. Halsey entitled "The Metric System in Export Trade." Unfavorable to the adoption of the metric system.

POWER AND TRANSMISSION

Air Compressors

Lubrication of Air Compressors (89038 A). W. H. Callan. 2500 w. Am Mach—Sept. 26, 1918. Treats of the heat condition of the walls of an air compressor, and gives a series of tests of various oils.

Compressed Air

Compressed Air to Win War (88899). Frank Richards. 2500 w. Com Air Mag—Sept., 1918. Serial, 1st part. Reviews the history of compressed air in its modern uses and adaptations.

Elevators

Development of V-Groove Elevator (88553). Charles Reedy. Abstract of paper before Elevator Mfrs. Assn. 3500 w. Natl Engr—Sept., 1918. History of experiments, discussing various makes of traction drive.

Fuel Economy

Saving Coal by Efficient Pulleys (88940 N). Charles H. Machen. Ills. 2000 w. Am Mach—Sept. 19, 1918. Discusses loss of power due to belt slip.

Plant Design

Engineer's Life Not a Bed of Roses When Things Go Wrong (88626). S. Balmfirth. Ills. 2500 w. Pwr House—Aug., 1918. Poorly designed plant adds greatly to the labors of the engineer and is a source of danger.

Salt Plant

New Plant of the Pennsylvania Salt Manufacturing Company (88832). Ills. 4500 w. Power—Sept. 17, 1918. Interesting addition to a power plant serving a works making caustic soda and bleaching powder by the electrolytic process.

Sources of Energy

L'Utilisation Des Forces Naturelles (89084 B). L. De Launay. 3600 w. La Nature—Sept. 7, 1918. Utilization of natural sources of energy: wind, waves, solar radiation, terrestrial heat and gravity.

Water Power

Water Power in the Empire (89077). 1500 w. Times Engng Supp—Aug., 1918. The great need for development. Preliminary report of British Water Power Committee.

Water-Power in the British Empire (88594 A). 2500 w. Elec Rev—Aug. 16, 1918. Serial, 1st part. Conclusions from recently issued preliminary report of the Water-power Committee.

STEAM ENGINEERING

Baffles

The Effect Upon Fuel Economy of Different Arrangements of Baffles in Boiler Tubes (88555 A). William G. Eager. Ills. 5000 w. A S M E, Jl—Sept., 1918. Report of tests made on three Heine boilers.

Blower

Blower for Water-Tube Boiler Plant at Bristol Electricity Works (88720 A). Ills. & Plate. 600 w. Engng—Aug. 2, 1918. Detailed description.

Boiler Rooms

Boiler-Room Management Plan (89007). T. N. Wynne. 2500 w. Elec Wld—Sept. 21, 1918. Great saving by the investment in trained men and adequate instruments.

Boilers

Boiler Repairs (88490). A. D. Palmer. Ills. 2200 w. Pwr Pt Eng—Sept. 1, 1918. Methods of patching a boiler.

Examination of Steam Boilers at Collieries (88606 A). Edward Ingham. Ills. 3000 w. Colly Gdn—Aug. 16, 1918. Defects to be looked for in internal and external examination.

Steam Boiler Regulation and Control (89026). Albert A. Straub. Charts & Ills. 2000 w. Power—Sept. 24, 1918. Importance of proper handling of the damper for controlling the draft.

Boiler Walls

New Data on Boiler Walls (88552). J. Crow Taylor. 1200 w. Natl Engr—Sept., 1918. Experiments indicate that an air space is not as good an insulator as a solid wall.

Clinkering

Clinkering: Its Causes and Prevention (88583). M. A. Saller. 1200 w. Power—Sept. 3, 1918. Can usually be avoided by carrying a thin fire; firing in small charges; avoiding stirring fire; and extinguishing live coals falling through the grate.

Condensers

A Flexible Condenser Installation (88488). A. H. Ganshird. Ills. 1000 w. Pwr Pt Eng—Sept. 1, 1918. Twin shell surface condenser solves problem of low headroom under cross-compound turbine unit.

Condensers and Condenser Engineering Practice (88916 N). D. D. Pendleton. 28 pp. Assn I S E E—Sept., 1918. Discusses condensers for steam prime movers. Types, their capacity and duty, etc.

Engine Stops

Automatic Engine Stops (88914 N). Walter Greenwood. Ills. 10 pp. Assn I S E E—Sept., 1918. Mechanical principles involved, causes of failure, kinds of stops, etc.

Feed Water

Using Navy Compound (88802). A. C. McHugh. 2200 w. Pwr Pt Eng—Sept. 15, 1918. Specifications for Navy compound; methods of making daily tests of boiler water.

Fuel

Practical Fuel Conservation (88551). F. C. Wagner. 5000 w. Natl Engr—Sept., 1918. Suggestions for stationary engineers for conserving coal.

Power Plants and the Fuel Situation (88486). A. P. Connor. 2500 w. Pwr Pt Eng—Sept. 1, 1918. The administration's attitude toward the acquiring of coal, storage, use of exhaust, and refrigeration.

Problems Involved in Fuel Changes (88671). A. Bement. 2500 w. Power—Sept. 10, 1918. Ash and not coal is the trouble maker. Describes instances and remedies.

The Use of Lignite, Bagasse, and Wood Waste for Power Generation and Other Purposes (88620 A). John B. C. Kershaw. Ills. 3500 w. Engr—Aug. 9, 1918. Serial, 1st part. The present number deals with methods of utilizing lignite.

Wood Fuel (88554). Albert A. Cary. 1800 w. Natl Engr—Sept., 1918. Examples of successful wood-burning furnaces.

Gage Glass

The Boiler Gage Glass (88977 N). William L. DeBaufre. Ills. 2200 w. Am Soc Nav Engrs, Jl—Aug., 1918. Explains how to determine the actual weight of water contained in a boiler and gives the proper corrections to be applied.

Induced Draft

European Practice in the Design of Induced Draft Plants (88625). Frank C. Perkins. Ills. 4000 w. Pwr House—Aug., 1918. Advantages over natural draft. The limitations, the various systems, etc.

Low Vacuum

Diagnosing and Correcting the Causes of Low Vacuum (88993). Hartley Le H. Smith. 5000 w. Elec Ry Jl—Sept. 21, 1918. Maintenance of surface condensers and auxiliaries the price of getting good results in the turbine or engine room.

Pressure Losses

Pressure Losses in Steam Plants (88801). R. S. Hawley. 2000 w. Pwr Pt Eng—Sept. 15, 1918. Causes; distinction between losses due to throttling and radiation.

Scale

Boiler-Tube Scale; Its Removal with Kerosene as Practiced at the Fuel-Oil Testing Plant (88974 N). Albert M. Penn. Ills. 1500 w. Am Soc Nav Engrs, Jl—Aug., 1918. Successful method.

Stokers

Design and Construction of Mechanical Chain-grate Stokers (88995 A). W. H. Grantham. Ills. 1800 w. Mech Wld—Aug. 30, 1918. Serial, 1st part. Types and their operation.

The Stoker of the Future (89002). Joseph Harrington. 1500 w. Elec Rev, Chi—Sept. 21, 1918. Analysis of mechanical stoker evolution as influenced by coal characteristics, clinker, efficiency and rate of combustion.

Superheated Steam

Superheated Steam Accessories (89071). 2000 w. Times Engng Supp—Aug., 1918. Piping, valves, joints, best materials to use, etc.

Advantages of High Pressure and Superheat as Affecting Steam-Plant Efficiency (88556 A). Eskil Berg, with short discussion. 2500 w. A S M E, Jl—Sept., 1918. Discusses possible improvements, showing that best results come from combined use of high pressure and superheat.

To avoid error, please order by title and number only.

Tars

The Tars Distilled from Bituminous Coal in Hand-Fired Furnaces (88871). S. H. Katz. Ills. 13 pp. U S Bur Mines—Tech paper 195. Results of tests dealing especially with the liquid, or tar part, at ordinary temperatures, of the volatile matter evolved in a coal fire.

Turbines

A 35,000 Kw. Turbine is Wrecked in Northwest Station, Chicago (88585). Ills. 2000 w. Power—Sept. 3, 1918. Detailed description. Failure of the 19-inch wheel the probable cause.

Modern Steam Turbines (88623 A). J. Humphrey. Ills. 2700 w. Ir & Cl Trds Rev—Aug. 9, 1918. Describes a new blading system which removes all chance of trouble from fine radial clearances. Also principal types at present in operation.

TRANSPORTING AND CONVEYING

Coal Handling

Handling Roundhouse Coal (88670). Ills. 1800 w. Power—Sept. 10, 1918. A modern coal-handling system of belt conveyors.

Conveying

Driving Power Required by Conveyors of Various Types (88891 B). R. F. Muirhead. 2500 w. Cas Eng Mthly—Aug., 1918. Power required to transport material between given terminals and power consumption.

The Early History of Conveying by Mechanical Means (88892 B). G. F. Zimmer. Ills. 3000 w. Cas Eng Mthly—Aug., 1918. Serial, 1st part. Historical aspect of continuous handling devices for bulk material of various kinds.

Conveyors

Conveyor at the Wellpark Brewery, Glasgow (88845 A). G. F. Zimmer. Ills. 1500 w. Engng—Aug. 16, 1918. A new departure combining the push-bar or drag-link conveyor and the roller runway.

Crane Motors

Bridge Motors for Overhead Traveling Cranes (88915 N). R. H. McLain. 9 pp. Assn I S E E—Sept., 1918. Rules for selecting the proper size of motor and gear ratio for bridge motion.

Haulage

Heavy Construction Hauling Practice Modified by War Conditions (88483 A). George H. Pride. 2000 w. Eng News-Rec—Aug. 29, 1918. Practice developed in the construction of cantonments.

Material Handling

Efficiency in the Handling of Railway Supplies (88640). Charles E. Parks. Ills. 3500 w. Ry Age—Sept. 6, 1918. Serial, 1st part. Methods employed by the Santa Fe in storing and handling material.

Unloading

Portable Pneumatic Grain Unloading Plant (88614 A). Ills. 1200 w. Engr—Aug. 2, 1918. Details of a plant recently tested at Ipswich.

ELECTRICAL ENGINEERING

COMMUNICATION

Service Charge

Service Connection Charge Ordered (88667). 2000 w. Telephony—Sept. 7, 1918. Postmaster-General orders telephone companies to charge for installation of telephones for new subscribers and for moving instruments.

Telephony

Compensation for Government Control (88719 A). F. B. MacKinnon. 4500 w. Tel Engr—Sept., 1918. Statement given to the press at midnight July 31, by Postmaster General Burleson, with discussion of the problem of compensation for use of the properties.

Costs of Special Service and Plant (88529). Ward H. Snook. 1200 w. Telephony—Aug. 31, 1918. Accounting system.

ELECTRO-CHEMISTRY

Electrometallurgy

Electric Steel Making (88500 A). Arthur V. Farr. Ills. 2000 w. Machy—Sept., 1918. Importance and growth of this industry.

Nitrogen

A La Conquête De L'Azote Atmosphérique (89066 B). H. M. Nagant. 12000 w. Rev Trimestrielle Canadienne—Aug., 1918. Sources and applications of nitrogen; its extraction from the atmosphere.

Organic Waste

Methods for Recovery of Useful Products (89073). 2100 w. Times Engng Supp—Aug., 1918. Various processes for recovery of facts, grease, etc., from garbage and offal.

Zinc

La Métallurgie Électrothermique Du Zinc (89080 B). J. Escard. Ills. 4000 w. Génie Civil—Aug. 17, 1918. Serial, 1st part. Zinc smelting in the electric furnace. Advantages.

ELECTRO-PHYSICS

Magnetic Pull

Magnetic Pull in Electric Machines (88905 D). E. Rosenberg. 45 pp. A I E E, Pro—Sept., 1918. Investigates the occurrence and the effect of unbalanced magnetic pull in electric machines and derives formulas for use of the designer.

Critical Review of the Bibliography on Unbalanced Magnetic Pull in Dynamo-Electric Machines (88904 D). Alexander Gray and J. G. Pertsch. 1200 w. A I E E, Pro—Sept., 1918.

Magnetic Susceptibility

See same heading under Measurement.

Magnetism

Terrestrial Magnetism in Relation to Mine Surveying (88881 N). C. Chree, with discussion. 41 pp. Instn Min Engrs, Trans—Aug.-Sept., 1918. Account of work in progress in terrestrial magnetism, and information being accumulated.

Radiations

See same heading under Measurement.

Resistances

Graphical Methods for Resistances in Parallel (89041 A). W. T. Maccall. 1200 w. Elec Rev—Sept. 6, 1918. Explains several constructions.

GENERATING STATIONS

Army Requirements

Electrical Developments for American Army (89003). R. K. Tomlin, Jr. Ills. 3000 w. Elec Wld—Sept. 21, 1918. The requirements of the American Expeditionary Forces and what is being done to meet them.

Cincinnati

Cincinnati's New Generating Station (88584). Ills. & Plate. 4000 w. Power—Sept. 3, 1918. Big bulk station with installed capacity of 50,000 kw. in two units.

Cincinnati's New 100,000-Kilowatt Power Station (88818). Ills. 1800 w. Elec Rev, Chi—Sept. 14, 1918. Serial, 1st part. Details of layout and mechanical equipment.

Coal Storage

Coal Storage Systems for Power Plants (88803). Ills. 1700 w. Pwr Pt Eng—Sept. 15, 1918. General methods of storing and reclaiming coal.

Earth Connections

Earthing Power-Station Equipment (89028). P. H. Adams. Ills. 2500 w Power—Sept. 24, 1918. Discusses the earth connections and reasons for making them.

Hydro-Electric

Hydro-Electric Power in Canterbury, New Zealand (88894 A). Ills. 2500 w Elec Rev—Aug. 30, 1918. Particulars regarding the development of power from Lake Coleridge.

The Great Lake Hydro-Electric Development of Tasmania (88580). Ludwig W. Schmidt. Ills. 1800 w. Power—Sept. 3, 1918. Interesting features of a 100,000-hp. development undertaken by private enterprise and completed with the aid of the government of Tasmania.

Italy

Future Electric Development in Italy (88624 A). 1300 w. Ir & Cl Trds Rev—Aug. 9, 1918. From an article by E. Strachan Morgan in the *Anglo-Italian Rev.* Past accomplishments and future outlook.

Ohio

More Energy for Mansfield District (88800). Ills. 2500 w. Pwr Pt Eng—Sept. 15, 1918. New Melco, O., plant utilizes both natural gas and coal.

Power

Economic Proportion of Hydro-electric and Steam Power (88906 D). Frank G. Baum. 1000 w. A I E E, Pro—Sept., 1918. A new method of determining what proportion of generation should be hydro-electric and what steam, from the standpoint of economics.

Power Control

Discussion on "The Control of Large Amounts of Power" (89104 N). 13 pp. Instn E E, Jl—July, 1918. Paper by E. B. Wedmore is discussed.

Rates

Attitude of Central Stations on Rates (88648). 2000 w. Elec Wld—Sept. 7, 1918. Economic changes in rate making policies and practice to be anticipated as result of war.

Cost Versus Value of Service in Rate Making—I (88534). John Bauer. 1500 w. Elec Wld—Aug. 31, 1918. Serial, 1st part. Discussion of fundamental factors to be considered in public utility system.

Substations

Automatically Remote-Controlled Synchronous - Motor - Generator Substation (88819). William Thomas Snyder. Ills. 800 w. Elec Rev, Chi—Sept. 14, 1918. Relative cost of automatic and manually-operated substation and mode of operating a station of 1000-kw. capacity.

Remote Controlled Sub-Station (88919 N). W. T. Snyder. Ills. 7 pp. Assn I S E E—Sept., 1918. Detailed description of a type, its operation and cost.

The Outdoor Substation in War Service (89004). E. B. Meyer. Ills. 1800 w. Elec Wld—Sept. 21, 1918. Its use has made it possible to meet demands and conserve material and labor.

The Standard Outdoor Substation (88683 A). J. T. Bronson. Ills. 3000 w. Gen Elec Rev—Sept., 1918. Outlines the requirements of outdoor switching apparatus and the types of equipment.

Turbine Plant

New Turbine Plant at Hull (88597 A). Ills. 1500 w. Elec'n—June 14, 1918. Detailed description of three-phase supply to augment existing system.

Winona

The New 5000-Kilowatt Station at Winona, Minn. (88533). Ills. 2000 w. Elec Rev, Chi—Aug. 31, 1918. Mechanical and electrical features of Wisconsin Ry., Light and Power plant.

GENERATORS AND MOTORS

Alternators

The Behavior of Alternators with Zero Power-Factor Leading Current (89016 A). F. D. Newbury. 1500 w. Elec Jl—Sept., 1918. Discusses self-excitation, and related matters.

Balancing

The Balancing of Heavy Rotors (88975 N). M. W. Turbet. Ills. 2500 w. Am Soc Nav Engrs, Jl—Aug., 1918. A mathematical study.

Commutators

Calculation of Commutators of Alternating-Current Machines (88595 A). M. Schenkel. 1600 w. Elec'n—June 14, 1918. Formulæ are given and their application shown.

Electrical Apparatus

Installation and Care of Large Electrical Apparatus for Steel Mills (89011 A). O. Needham. 4000 w. Elec Jl—Sept., 1918. Discusses precautions applying particularly to the larger motors and their accessories.

The Protection of Electrical Apparatus (89013 A). P. M. Lincoln. 3000 w. Elec Jl—Sept., 1918. Various methods of securing the integrity of electrical insulation.

The Use of Graphic Instruments in Improving the Operation of Electrical Apparatus and Reducing Cost of Maintenance (89015 A). J. H. Overpeck. 2000 w. Elec Jl—Sept., 1918. Analysis of motor failures and method of studying the operating cycle by means of graphic instruments.

Induction Motors

Control of Induction Motors (88647). C. E. Clewell. Ills. 2000 w. Elec Wld—Sept. 7, 1918. Fundamental features of induction-motor starters, details of types designed to cover special requirements during the starting interval.

High-Power Factor Induction Motors (88820). Marius Latour. Ills. 5000 w. Elec Wld—Sept. 14, 1918. Various arrangements for variable-speed motors that have been proposed in the last fifteen years, with particular reference to French developments.

Notes on the Three-phase Induction Motor (88602 A). L. Fokes. Ills. 3500 w. Colly Gdn—Aug. 9, 1918. Fundamental principles of operation and constructional details.

Insulation

Methods of Insulating A. C. Generator Coils (88582). H. D. Stephens. Ills. 1000 w. Power—Sept. 3, 1918. Characteristics and merits of the various kinds of insulation and methods of applying.

Motor Ratings

Standardization of Ratings of Large Rolling Mill Motors (88917 N). K. A. Pauly. 10 pp. Assn I S E E—Sept., 1918. The advantages of the standardization of the name or rating of roll motors, and favoring the A. I. E. E. rating.

Motor Selection

Applying Engineering Principles Properly in Motor Selection (88994). C. W. Squier. Curves. 2200 w. Elec Ry Jl—Sept. 21, 1918. Shows how to select motor best adapted to meet given requirements.

How to Buy Direct-Current General Utility Motors (88939 A). A. Brunt. Ill. 2500 w. Am Mach—Sept. 19, 1918. Remarks on lack of judgment in writing the specifications for direct-drive work.

Power Factor

The Power Factor (88768 A). 2500 w. Colly Gdn—Aug. 23, 1918. Explains how the power factor arises.

Synchronizing

Synchronising of Alternators (88599 A). E. Styff. Abstract from *Electro. Zeit.* Ills. 1000 w. Elec'n—Aug. 2, 1918. Discusses combinations of instruments, lamps and mode of connections.

Synchronous Motors

Synchronous Motor Action (88489). Gordon Fox. Ills. 3500 w. Pwr Pt Eng—Sept. 1, 1918. Principles of operation.

Ventilation

The Ventilation of Turbo-Generators (89103 A). J. Humphrey. Ills. 4000 w. Ir & Cl Trds Rev—Sept. 6, 1918. Importance of clean air and means of securing it.

ILLUMINATION

Floodlighting

Simple Methods for Solving Floodlighting Problems (88682 A). H. E. Butler. Ills. 1200 w. Gen Elec Rev—Sept., 1918. Methods and their application to both high-intensity and low-intensity illumination.

Incandescent Lamps

Lamp Policy of the Fuel Administration (88650). 4000 w. Elec Wld—Sept. 7, 1918. By eliminating inefficient types of incandescent lamps the U. S. Fuel Administration expects to save more than 1,000,000 tons of coal a year.

Industrial Lighting

Industrial Illumination (88886 B). Ills. 15 pp. Cas Eng Mthly—Aug., 1918. Second of a series of articles dealing with practical welfare work and the question of eliminating dangers. Discusses both natural and artificial lighting from these points of view.

How Lighting Interests Can Best Serve the Nation (88697). F. H. Bernhard. Ills. 2500 w. Elec Rev, Chi—Sept. 7, 1918. Needs of industrial lighting.

Some Important Phases of Industrial Lighting (88698). W. T. Blackwell. Ills. 2000 w. Elec Rev, Chi—Sept. 7, 1918. Features of factory lighting.

Lighting Code

New Industrial Lighting Code for Wisconsin (88536). John A. Hoeveler. Ills. 2500 w. Elec Wld—Aug. 31, 1918. New rules define terms used and provide for definite values of illumination and glare.

Lighting Units

Selection of Lighting Units (89008). Davis H. Tuck. Ills. 1500 w. Elec Wld—Sept. 21, 1918. Principles outlined. Efficiency of reflectors.

Light Treatment

The Relation of Light to Health (88828 A). Charles E. de M. Sajous. 4500 w. E Cb Phila, Jl—Sept., 1918. Possibilities for the development of the applications of light for the preservation of help and care of disease.

Localized Lighting

On Preferred Proportions in Combining General and Localized Lighting (88722 C). F. C. Caldwell and W. M. Holmes, with discussions. Ills. 20 pp. Ill Eng Soc, Trans—Aug. 30, 1918. Report of test, stating conditions and results.

Motion Pictures

Les Projections Cinématographiques (89082 B). Ils. 2600 w. Génie Civil—Aug. 24, 1918. Incandescent lamps for motion picture projection.

Radio-activity

On the Luminescence Due to Radioactivity (88902 B). Enoch Karrer and D. H. Kabakjian. Ills. 24 pp. Fkn Inst, Jl—Sept., 1918. Characteristics of self-luminous materials.

MEASUREMENT

Balancing

Methods of Balancing Rotors (89014 A). C. C. Brinton. Ills. 2000 w. Elec Jl—Sept., 1918. Considers static balance and dynamic or running balance.

Dynamic Balancing of Rotating Sections (88535). Cecil Hering. 1800 w. Elec Wld—Aug. 31, 1918. Rational unit for expressing and measuring the tolerance allowed.

Harmonic Analysis

Application of Harmonic Analysis to the Theory of Synchronous Machines (88907 D). Waldo V. Lyon. 37 pp. A I E E, Pro—Sept., 1918. Shows the presence of harmonics in the current and voltage and in the distribution of the airgap flux. Methods for determining effects, applying to a number of cases.

Magnetic Susceptibility

La Susceptibilidad Magnética Del Bismuto Y Del Antimonio (89059 D). H. Isnardi. Ills. 4500 w. Universidad Nacional De La Plata—Dec., 1917. Magnetic reluctance of bismuth and antimony.

Meter Testing

The Percentage Error (89042 A). T. T. Bullen. 1000 w. Elec Rev—Sept. 6, 1918. Ways of working and writing results of meter tests.

Mica

On the Temperature Variation of the Electrical Conductivity of Mica (88598 A). H. H. Poole. Abstract of an article in *Phil. Mag.* Ills. 1500 w. Elec'n—June 14, 1918. Experimental investigations and results.

Photometry

An Integrating Hemisphere (88723 C). F. A. Benford, Jr. Ills. 28 pp. Ill Eng Soc, Trans—Aug. 30, 1918. Shows that the hemisphere has certain theoretical advantages.

Pyrometers

See same heading under MECHANICAL ENGINEERING, *Measurement.*

Radiations

Spectroradiometric Investigation of the Transmission of Various Substances (88713). W. W. Coblentz, W. B. Emerson, and M. B. Long. 24 pp. U S Bur Stds, Sci paper 325—Aug. 8, 1918. Data on spectral transmission of radiant energy.

Transformers

See Test Ring Method, under Transformers.

POWER APPLICATIONS

Cranes

Rules for Safe Operation of Electric Cranes (88912 N). 7 pp. Assn I S E E—Sept., 1918. Code of rules presented by the Safety Committee.

Drainage

Electrische polderbemaling (89056 B). A. W. C. Dwars. Ills. 9800 w. Ingenieur—July 27, 1918. Electric pumping for drained lands in Holland. Kinds of pumps used.

Electroculture

Notes on Electroculture (88596 A). Ingvar Jörgensen. 3000 w. Elec'n—June 14, 1918. Deals with the branch of electroculture from an overhead network.

Fire Alarms

Some Notes on Public Fire-Alarm Systems (88838 A). G. W. Stubbings. 1500 w. Elec Rev—Aug. 23, 1918. Mode of action of the usual system with technical details.

Mill Drive

Electrically Driven Mills (88918 N). J. T. Sturdevant. Ills. 5 pp. Am Ir & St Elec Engrs—Sept., 1918. Shows the layout, equipment, power consumption, tonnages, and capacities of eleven installations at the Lehigh plant of the Bethlehem Steel Co.

Mill Electrification

Electrification of Steam Driven Three-High Merchant Mill at the Frodingham Iron and Steel Works (88600 A). Ills. 1800 w. Elec'n—Aug. 2, 1918. Problems solved with details of the work.

Mine Pumps

Oerlikon Three-Phase, Low-Speed, Variable-Speed Motors with Large Flywheel Effect, for Direct Coupling to Mine Ram Pumps (88841 A). Ills. 1200 w. Elec'n—Aug. 23, 1918. Serial, 1st part. Characteristics of plant at the Dolcoath mines.

Printing Presses

Electrically-Driven Printing Presses (88852 A). Ills. 2500 w. Engr—Aug. 16, 1918. Particulars regarding a series of electric motors recently installed in Edinburgh.

Welding

Electric Arc Welding (88908 D). A. M. Candy. Ills. 12 pp A I E E, Pro—Sept., 1918. Methods and applications.

Bibliography of Electric Welding (88684 A). William F. Jacob. 2500 w. Gen Elec Rev—Sept., 1918. Progress in the art; its application to shipbuilding.

Electric Arc Welding (88945 N). H. L. Unland, with discussion. Ills. 33 pp. Assn I S E E—June, 1918. Its development and applications.

TRANSFORMERS

Test Ring Method

Current Transformer Ratio and Phase Error by Test Ring Method (88909 D). H. S. Baker. Ills. 2500 w. A I E E, Pro—Sept., 1918. Detailed description of apparatus and method of testing.

TRANSMISSION AND DISTRIBUTION

Belgium

La Reconstitution De La Belgique (89079 B). J. Carlier. 3000 w. Génie Civil—Aug. 10, 1918. Plan to coördinate and centralize entire output of electric central stations.

Cables

Detective and Protective Devices for Electric Cables (88619 A). Ills. 700 w. Engr—Aug. 9, 1918. Describes a test sheath cable and a special "protective" system devised which is a combination of leakage and core balance protection, combined with detective arrangements and alarm devices.

Circuit Breakers

High-speed Circuit Breakers for Chicago, Milwaukee & St. Paul Electrification (88680 A). C. H. Hill. 1000 w. Gen Elec Rev—Sept., 1918. Details of construction of unusual equipment.

Conductors

Investigation of Heating of Conductors (88821). Henry C. Horstman and Victor Tousley. 800 w. Elec Wld—Sept. 14, 1918. Serial, 1st part. Evidence indicates that rating should be modified to permit use of smaller conductors where the load is intermittent.

Conduits

A Few Facts About Conduit Fishing (88531). Terrell Croft. Ills. 1000 w. Elec Rev, Chi—Aug. 24, 1918. Serial, 1st part. Discusses methods and equipment.

Electrical Supply

Some Transient Phenomena in Electrical Supply Systems (89049 N). E. W. Marchant, with bibliography and discussions. 28 pp. Instn E E, Jl—July, 1918. Gives oscillograms, explaining results, etc.

Fuses

The Development of 2,500-Volt Fuses (88646). Robert Charles Cole. 2200 w. Elec Wld—Sept. 7, 1918. Experimental investigations leading to the development of a fuse for high-power short circuits.

High-Tension Lines

Charging Currents and Earthing Devices in Transmission Lines (88839 A). H. Behrend. Abstract of an article in *Elektro. Zeit.* Diagrams. 2000 w. Elec'n—July 12, 1918. Special protective devices.

Insulation

Pin or Arm Insulation Not Sufficient (88537). Ills. 2200 w. Elec Wld—Aug. 31, 1918. Placing dependence on it on high-voltage lines, especially where subjected to salt air, may cause charring due to leakage. Some remedies suggested.

Power Factor

Improving Power-Factor by Static Condenser (88532). Also editorial. Ills. 3000 w. Elec Rev, Chi—Aug. 31, 1918. Application of the static condenser.

Synchronous Condensers

Improving Power Factor and Voltage Regulation (88822). J. T. Peyton. Ills. 1500 w. Elec Wld—Sept. 14, 1918. By using synchronous condensers Pennsylvania Co. has met increased demands.

CIVIL ENGINEERING

BRIDGES

Flat Slab

The Advantages of Flat-Slab Construction for Bridges (88506). A. B. Cohen. Ills. 2200 w. Eng & Con—Aug. 28, 1918. Statement of advantages; examples.

France

Bridge at Lyons Named in Honor of President Wilson (88481 A). Ills. 700 w. Eng News-Rec—Aug. 29, 1918. Arch structure with twin masonry ribs carrying reinforced-concrete floor peculiar to French design.

Hell Gate

The Hell Gate Arch Bridge and Approaches of the New York Connecting Railroad Over the East River in New York City (88731 D). 3000 w. A S C E, Pro—Aug., 1918. Continued discussion of the paper by O. H. Ammann.

Stress Measurements on the Hell Gate Arch Bridge (88732 D). 30 pp. A S C E, Pro—Aug., 1918. Continued discussion of D. B. Steinman's paper.

Kettle Rapids

Nelson River Crossed by Hudson Bay Railway on Large Continuous-Truss Bridge (88478 A). Ills. 3000 w. Eng News-Rec—Aug. 29, 1918. Cantilever erection of 400-ft. span made necessary.

Poughkeepsie

Strengthening Poughkeepsie Bridge Superstructure (88811). Ills. 2500 w. Ry Age—Sept. 13, 1918. Gauntlet track operation will permit heavier loading.

Skew Bridges

Skew Subway Bridges Require Special Design (88959 A). Ills. 1000 w. Eng News-Rec—Sept. 19, 1918. Details of reinforced concrete structures on track-elevation work in Chicago.

Steel Arch

The Economics of Steel Arch Bridges (88737 D). Ills. 27 pp. A S C E, Pro—Aug., 1918. Continued discussion of J. A. L. Waddell's paper.

Viaducts

Renewing the Moorabool Viaduct (88835 N). A. Goudy. Ills. 1000 w. Comwh Engr—Aug., 1918. A great undertaking by the Victorian Rys.

CONSTRUCTION

Army Depot

Army Intermediate Depot in France Problem in Getting Labor and Supplies (88778 A). Robert K. Tomlin, Jr. Ills. 2500 w. Eng News-Rec—Sept. 12, 1918. Project covers site six miles long. Types of warehouses being built.

Cantonments

Recreation Buildings for Officers and Men at the National Army Cantonments (88541 B). Ills. 2200 w. Arch For—Aug., 1918. Detailed descriptions.

Chimneys

Graphic Method of Chimney Design (88586). H. M. Brayton. Ills. 1000 w. Power—Sept. 3, 1918. Method of designing without calculations by combining long and complicated formulæ.

Columns

Discussion on Final Report of the Special Committee on Steel Columns and Struts (88739 D). 20 pp. A S C E, Pro—Aug., 1918. Continued from April issue.

Concrete Pit

Concrete Lined Pit Built Without Shifting Bracing (88783 A). H. D. Loring. Ills. 1200 w. Eng News-Rec—Sept. 12, 1918. Work at Carthage, O. Construction speed increased by sacrificing salvage of sheeting.

Contracts

Cost-Plus Contracts (88505). P. B. Glasco. 1200 w. Eng & Con—Aug. 28, 1918. The advantages of the system.

Housing

Engineering Possibilities of Circular Housing Plan (88524). G. J. Lamb. Ills. 1200 w. Can Engr—Aug. 29, 1918. Advantages include economy of fuel, more sunlight, better surroundings, etc.

Mining Towns

Fireco—A New Mining Town in West Virginia (88788). Ills. 3800 w. Cl Age—Sept. 12, 1918. Town planned for social and physical welfare.

Partitions

Practical Points in the Design and Construction of Partitions (88509). H. L. Barraclough. From paper before Concrete Inst., London. 1500 w. Eng & Con—Aug. 28, 1918. Information concerning partition slabs and their erection.

Scaffolds

Safe Construction of Scaffolds and Falsework (88934). T. F. Foltz. Abstract of paper before the Nat. Safety Council. 3500 w. Eng & Con—Sept. 18, 1918. Directions for various types of scaffolds and the general requirements.

Shafts

Drop Shafts Sunk Through Buried Tree Trunks by Dredging (88779 A). Ills. 1600 w. Eng News-Rec—Sept. 12, 1918. Unusual work in connection with foundations for power station in Kansas City.

Tunnels

Connecting Subway Tunnel Tubes in Quicksand (88849 A). Ills. From N. Y. *Contracting.* 1500 w. Engng—Aug. 16, 1918. Details of interesting work in Brooklyn in Section 3, route 48, of the N. Y. subway system.

IRRIGATION AND RECLAMATION

Run-off

Peak Run-off Data on Restricted Dry-Wash Channel (88957 A). Ills. 1000 w. Eng News-Rec—Sept. 19, 1918. Records taken at Lytle Creek, California, in Jan.,

MATERIALS OF CONSTRUCTION

Brick

Brick Used as a Means of Interior Decoration (88542 B). H. B. Russell. Ils. 1200 w. Arch For—Aug., 1918. Details of the city house of E. H. Noyes, Boston.

The Manufacture of Silica Brick (88771 D). H. Le Chatelier and B. Bogitch. Ills. 28 pp. A I M E, Bul—Sept., 1918. Methods of investigation of the conditions for the manufacture of high-grade brick.

Building Stones

Report on the Building and Ornamental Stones of Canada (88708 N). William A. Parks. Ills. 225 pp. Can Dept Mines—No. 452. Account of the stones occurring in British Columbia.

Burma

The Material Resources of Burma (89000 N). Harvey Adamson. Map. 39 pp. Imp Inst, Bul—Jan.-March, 1918. Information showing Burma to be a land of rich resources.

Concrete

Chemistry of Concrete (88664). Arch. Blackie. Read before the Engng. Inst. of Canada. 2500 w. Can Engr—Sept. 5, 1918. Causes of disintegration.

Concrete in Alkali Soil at Saskatoon (88661). H. McI. Weir. Read before Engng. Inst. of Canada. 2000 w. Can Engr—Sept. 5, 1918. Damage to structures caused supposedly by the action of alkali.

Discussion on Final Report of the Special Committee on Concrete and Reinforced Concrete (88740 D). 7 pp. A S C E, Pro—Aug., 1918. Continued from Feb. issue.

Weighing Concrete Materials Saved Cement on Three Big Dams (88479 A). H. H. Hunt. Ills. 2000 w. Eng News-Rec—Aug. 29, 1918. Proportioning by weight gave better concrete with less cement and without loss of speed.

Inspection

Outline of Methods of Inspection of Materials for Subway and Elevated Lines in New York City (88970 B). George L. Lucas. 5000 w. Mun Engrs, Jl—May-June, 1918. Methods, quantities, cost, etc.

Paint

Selecting an Economic Paint (88507). Robert Job. 1500 w. Eng & Con—Aug. 28, 1918. From a lecture at McGill Univ. Influence of size of pigment particles; paint specifications and testing.

Reinforced Concrete

Reinforced Concrete versus Salt, Brine and Sea-Water (88946 N). Henry Jermain Maude Creighton. 4400 w. Faraday Soc—July 23, 1918. Deals chiefly with the corrosion of iron reinforcements of concrete due to the action of brine.

Sands

Progress Report of Committee on Mechanical Analysis of Sands (88932 N). 10 pp. Am W-Wks Assn, Jl—Sept., 1918.

Wood

The Afforestation Question in Britain (89061 A). E. P. Stebbing. 1100 w. Nature—Aug. 15, 1918. Britain's timber supply and its use in war. Tree planting.

MEASUREMENT

Beams

The Design of Offset Beams (88688 A). Victor M. Summa. Ills. 1000 w. Ry Mech Engr—Sept., 1918. Discusses proper methods.

Beam Stresses

Distribution of Internal Work in Beams and Slabs (88578 A). Henry T. Eddy. 1600 w. Eng News-Rec—Sept. 5, 1918. Difference in amounts of energy stored in steel indicates dissimilarity in structural functions of concrete.

Bridge Maps

Method of Numbering County Bridges and Making Bridge and Drainage Map (88508). J. C. McLean. 1000 w. Eng & Con—Aug. 28, 1918. Outline of methods.

Earth Pressure

Computing the Lateral Pressure of Saturated Earth (88574 A). A. G. Husted. Ills. 1500 w. Eng News-Rec—Sept. 5, 1918. Proposed method takes account of separation of hydrostatic from earth pressure, but allows full hydrostatic pressure.

Mine Surveys

The Magnetic Meridian and the Orientation of Mine Surveys (88603 A). W. B. H. Lockerbie. 3000 w. Colly Gdn—Aug. 9, 1918. Shows that very precise orientation can be made by means of the magnetic needle.

Navigation

The Search for Instrumental Means to Enable Navigators to Observe the Altitude of a Celestial Body When the Horizon is Not Visible (88725 A). G. W. Littlehales. Ills. 2500 w. U S Nav Inst, Pro—Aug., 1918. Describes methods and instruments invented.

Structures

Structural Engineering (88609 A). 1800 w. Engng—Aug. 9, 1918. Editorial review of a paper by M. Charles Rabut, in *Rev. Gen. des Sci.* criticizing methods adopted for determining stresses.

Surveying

Problems in City Surveying (88986). William W. Perrie, with discussion. Ills. 2000 w. Can Engr—Sept. 19, 1918. Read before Ontario Land Surveyors Assn. Classes of surveys. Differences of opinions.

Stadia Surveys in the West (88527). G. C. Cowper. 3500 w. Can Engr—Aug. 29, 1918. Water areas on the prairies, their classification, calculation, etc.

Calculo Del Error En Area Cometido Al Medir Una Finca (89058 A). J. M. Logomasino. Ills. 1900 w. Rev Soc Cubana de Ingenieros—Aug., 1918. Calculation of errors in determining area of land.

Weirs

Verification of the Bazine Weir Formula by Hydro-Chemical Gaugings (88736 D). 2500 w. A S C E, Pro—Aug., 1918. Continued discussion of paper by Floyd A. Nagler, Jr.

Well Tests

Piezometers and Current Meters Used to Test Wells (88484 A). R. D. Klise. Ills. 1200 w. Eng News-Rec—Aug. 29, 1918. Flow records obtained and leaky casings located as part of water conservation work.

MUNICIPAL

City Planning

City Planning for Small Municipalities (88988). A. Pearsons Hoover. Abstracted from address before City Managers' Assn. 1300 w. Can Engr—Sept. 19, 1918. Points of special importance.

The St. Louis Zone Plan (88878 A). Harland Bartholomew. Ills. 27 pp. E Cb St L, Jl—July-Aug., 1918. Explanation of the building zone plan providing for three types of districts—height, area, and uses.

Pumping Stations

Electrically Operating Sewage Pumping Stations of Waterloo, Ia. (88744). 2000 w. Eng & Con—Sept. 11, 1918. Abstract of a paper by G. H. Kilpatrick.

Sewage Disposal

Design and Operation of Sewage Treatment Plants with Special Reference to Minnesota Conditions (88742). H. A. Whittaker. 1800 w. Eng & Con—Sept. 11, 1918. From report of Minn. State Board of Health.

Sewage Disposal (88662). Edward Willcox. Abstract from presidential address to the British Assn. of Mgrs. of Sewage Disposal Works. 2500 w. Can Engr—Sept. 5, 1918. Camp sewage, fertilizers, design of plants, etc.

Sewage Treatment Policies as Influenced by War Time Conditions (88762 A). George W. Fuller. 2000 w. Mun Eng—Sept., 1918. Where investments in sanitary works will do the most good.

Uruguay

Americans Build Sewer and Water Systems for Three Uruguayan Cities (88482 A). Albert A. Northrop. Ills. 1600 w. Eng News-Rec—Aug. 29, 1918. Work requiring five shiploads of materials, 7,000 miles from the base of supplies completed a year ahead of time.

Construction of Water and Sewerage Systems for the Cities of Salto, Paysandu and Mercedes, Republic of Uruguay, South America (88755 A). G. E. Hines. Ills. 5000 w. Mun Eng—Sept., 1918. Municipal improvements costing $5,000,000.

ROADS AND PAVEMENTS

Concrete

Some Design and Construction Features of Concrete Roads (88759 A). A. N. Johnson. 2500 w. Mun Eng—Sept., 1918. Discusses width and thickness of pavement and other construction features.

Construction

Mechanical Material Handling System Reduces Labor and Hauling Costs and Eliminates Waste in Construction of Michigan Road (88628). Ills. 700 w. Eng & Con—Sept. 4, 1918. Advantages of complete mechanical system for handling.

Financing

Financing Road Improvements (88528). Archibald McGillivray. 2000 w. Can Engr—Aug. 29, 1918. Explains the Manitoba policy.

Highways

Notes on Highway Design (88629). J. L. Harrison. 2000 w. Eng & Con—Sept. 4, 1918. Points to be considered.

Planning a System of Rural Highways (88660). W. M. Stewart. 2000 w. Can Engr—Sept. 5, 1918. Classification according to traffic.

Policy and Procedure of U. S. Highways Council During the War (88756 A). 1200 w. Mun Eng—Sept., 1918. Announcement of policy effective Sept. 10, 1918.

Work of the Highway Industries Association and Necessity for Closer Coöperation Between Federal, State and County Road Authorities (88758 A). H. G. Shirley. Address at N. C. Good Roads Assn. 1800 w. Mun Eng—Sept., 1918. The aims and objects.

Intersections

Proper Radius for Turns at Intersection of Highways (88956 A). G. S. Eaton. Ills. 1000 w. Eng News-Rec—Sept. 19, 1918. Permissible banking has small effect. Problem discussed.

Pavements

Build Permanent Pavements at New Aëronautical Station (88575 A). Samuel H. Lea. Ills. 1500 w. Eng News-Rec—Sept. 5, 1918. Roadways of concrete at Langley Field.

Present Need of Correct Interpretation of Pavement Behavior Under Constantly Increasing Traffic Requirements (88757 A). Maurice B. Greenough. Ills. 1000 w. Mun Eng—Sept., 1918. Types, etc.

Road Materials

Typical Specifications for Non-Bituminous Road Materials (88721 N). Prévost Hubbard and Frank H. Jackson, Jr. 38 pp. U S Dept Agri, Bul 704—Aug. 30, 1918. Typical specifications used in the construction and maintenance of various types of highways.

Road Work

Road Work in Manitoba (88989). M. A. Lyons. Read before Eng. Inst. of Canada. 2200 w. Can Engr—Sept. 19, 1918. Methods of construction and maintenance.

Saskatchewan

Financing Road Work in Saskatchewan (88525). H. S. Carpenter. 2000 w. Can Engr—Aug. 29, 1918. System for administering highway expenditures.

Truck Roads

Few Grades Over 5% on New Jersey Truck Roads (88549 A). Map & Ills. 800 w. Com Vhle—Sept. 1, 1918. New Jersey plans 655 miles of real truck roads with 20-ton bridges.

WATER SUPPLY

Artesian Supply

History of the Artesian Supply at Savannah, Georgia (88924 N). E. R. Conant. 10 pp. Am W-Wks Assn, Jl—Sept., 1918. History, geological data, etc.

Bacterial Removal

A Preliminary Analysis of the Degree and Nature of Bacterial Removal in Filtration Plants (88926 N). Abel Wolman. 2000 w. Am W-Wks Assn, Jl—Sept., 1918. Certain basic characteristics of rapid sand filtration.

California

Construction of Collection and Transmission System for Marin Municipal Water District (89024 A). Ills. & Map. 3500 w. West Eng—Sept., 1918. Detailed description of this work just north of San Francisco.

Camps

Water Supply and Sanitation at Government Camps and Shipyards (88921 N). Samuel A. Greeley. 1000 w. Am W-Wks Assn, Jl—Sept., 1918. The objects of the work and methods explained.

Cantonments

Sanitary Aspect of the Water Supplies at the Army Cantonments (88922 N). James T. B. Bowles. 1200 w. Am W-Wks Assn, Jl—Sept., 1918. The development of supplies.

Chicago

Sanitary Precautions Taken Prior to Opening Wilson Avenue Crib and Tunnel of Chicago Water Works (88763 A). John Dill Robertson and Herman N. Bundeson. Ills. 1000 w. Mun Eng—Sept., 1918. Design and construction features of works.

Dams

Construction Methods Used on the Junction Dam (88782 A). Ills. 1500 w. Eng News-Rec—Sept. 12, 1918. Excavating, concreting, and winter earth sluicing.

Improving Arch Action in Arch Dams (87738 D). 700 w. A S C E, Pro—Aug., 1918. Discussion of L. R. Jorgensen's paper.

Sixty-One-Foot Hydraulic-Fill Dam Rests on Earth Foundation (88781 A). William G. Fargo. Ills. 2200 w. Eng News-Rec—Sept. 12, 1918. Notable features of junction development in Southern Michigan.

Distribution

Some Phases of Work in the Distribution Section of the Water Division, St. Louis (88930 N). W. A. Foley. 1400 w. Am W-Wks Assn, Jl—Sept., 1918. Features not usually found in other municipalities.

France

American Army's Water-Works Projects in France Number About Four Hundred (88573 A). Robert K. Tomlin, Jr. Ills. 2500 w. Eng News-Rec—Sept. 5, 1918. Great range in size and character.

Mains

City of Detroit Offsets Labor Shortage by Using Machinery for All Water Main Construction (88761 A). Ills. 1000 w. Mun Eng—Sept., 1918. Details of machinery replacing hand labor.

Manifold

The Double 48-Inch Manifold at Bissell's Point, St. Louis (88928 N). C. M. Daily. 1800 w. Am W-Wks Assn, Jl—Sept., 1918. Brief history of the St. Louis water-works showing conditions, with description of the double 48-inch manifold.

New York

The Water Supply of New York (88617 A). Map & Ills. 2000 w. Engr—Aug. 9, 1918. Serial, 1st part. Condensed from paper by Alfred D. Flinn, before the Worcester Technical Club. Reviews the scheme for increasing the supply.

Pumps

The New 110 Million Gallon Pump at the Chain of Rocks, St. Louis (88929 N). L. A. Day. 1500 w. Am W-Wks Assn, Jl—Sept., 1918. Details of a new turbine-driven centrifugal pump.

Quality

The Practicability of Adopting Standards of Quality for Water Supplies (88920 N). Robert B. Morse and Abel Wolman. 30 pp. Am W-Wks Assn, Jl—Sept., 1918. The difficulties in establishing a standard.

Reservoirs

Determining the Regulating Effect of a Storage Reservoir (88577 A). Robert E. Horton. 1500 w. Eng News-Rec—Sept. 5, 1918. Differential equation for inflow, outflow, and storage relations solved by using time interval as independent variable.

Saskatchewan

The Development of Water Supplies for Rural Communities in Saskatchewan (88741). E. L. Miles. Ills. 1800 w. Eng & Con—Sept. 11, 1918. Abstract of paper before the Eng. Inst. of Canada. Development of springs, reservoirs, dams, etc.

Water Supply for Saskatchewan (88526). George Douglas Mackie. 2500 w. Can Engr—Aug. 29, 1918. Statement of conditions, explaining the difficulties.

Service Cocks

Loss of Head in Corporation Cocks and Service Pipes (88923 N). Bernard J. Bleistein. Ills. 1500 w. Am W-Wks Assn, Jl—Sept., 1918. A series of tests made in New York City.

Tanks

40,000 Gal. Reinforced Concrete Tower and Tank Built for $3,100 (88743). Ills. 1400 w. Eng & Con—Sept. 11, 1918. From paper by H. G. Overholt. Describes structure for New Trier, Minn.

War Burdens

Report of Committee on War Burdens of Water Works in the United States (88931 N). 40 pp. Am W-Wks Assn, Jl—Sept., 1918. Information concerning the effect on construction, operation and maintenance of water works.

Waste

Water Waste Elimination. Methods and Results at Oak Park, Ill. (88925 N). H. P. T. Matte. 2200 w. Am W-Wks Assn, Jl—Sept., 1918. Measures necessary to supplement complete meterage.

Water Treatment

Recent Development in Equipment Used in Ozone Method of Water Treatment (88764 A). Irwin D. Groak. Ills. 1000 w. Mun Eng—Sept., 1918. Three new ozone machines and their applications.

Some Aspects of Chemical Treatment at St. Louis Water Works (88927 N). A. V. Graf. 3000 w. Am W-Wks Assn, Jl—Sept., 1918. Explains conditions of the supply and gives details of treatment.

Water Waste

Economy in the Use of Water (88673 A). 2000 w. Ry & Loc Eng—Sept., 1918. The waste on railroads and methods of handling supplies, etc.

Water Works

Construction Methods Employed in Building the New Intake and Remodeled Reservoirs of the Oshkosh, Wisconsin, Water Works (88760 A). T. B. Jorgensen. Ills. 1000 w. Mun Eng—Sept., 1918. Detailed description.

Waterworks at St. Thomas, Ont. (88804). R. O. Wynne-Roberts. Ills. 1000 w. Can Engr—Sept. 12, 1918. Details of plant and outline of methods of treatment. Supply from creek and 32 artesian wells.

WATERWAYS AND HARBORS

Barge Canal

Canal Idle Under Railroad Administration (88895). Ills. 2500 w. Naut Gaz—Sept. 14, 1918. Critical discussion of the unsatisfactory conditions.

Boston Terminal

Boston Army Supply Base Will Be Valuable Permanent Port Terminal (88955 A). Ills. 2500 w. Eng News-Rec—Sept. 19, 1918. Sixty acres of storage space provided.

Flood Control

Detention Reservoirs With Spillway Outlets as an Agency in Flood Control (88735 D). 2500 w. A S C E, Pro—Aug., 1918. Continued discussion of H. M. Chittenden's paper.

Harbors

St. John Harbor (88990). Alex. Gray. Read before Eng. Inst. of Canada. 2000 w. Can Engr—Sept. 19, 1918. Explains conditions and the harbor development.

Ice Diversion

Ice Diversion, Hydraulic Models, and Hydraulic Similarity (88733 D). Ills. 25 pp. A S C E, Pro—Aug., 1918. Continued discussion of Benjamin F. Groat's paper.

Lock Gates

The Distribution of Stresses in Mitering Lock-Gates, with Special Reference to the Gates on the Panama Canal (88734 D). 1500 w. A S C E, Pro—Aug., 1918. Discussion of Henry Goldmark's paper.

New York

Joint Commission Rushes Study of Port of New York (88480 A). 1500 w. Eng News-Rec—Aug. 29, 1918. Engineering investigation of railways, steamships, lightering and trucking.

Ostia

Roma Porto di Mare e la Ferrovia Roma-Ostia (89057 B). G. Tian. Ills. 3300 w. Monitore Tecnico—Aug. 10, 1918. Serial, 1st part. Ostia, the port of Rome. Canal and railway connections.

Rhine

The Freedom of the Rhine (88854 A). 2000 w. Engr—Aug. 23, 1918. German project to canalize the Rhine and the objections of Switzerland.

De bevaarbaarmaking van den Duitschen Boven-Rijn (89052 B). C. A. Jolles. 3200 w. Ingenieur—July 6, 1918. Improvements in the upper (German) Rhine to facilitate navigation, or Germany only.

San Francisco

Improving Golden Gate Port (88559 A). Cruse Carriel. Ills. 800 w. Mar Rev—Sept., 1918. Improvements at San Francisco.

To avoid error, please order by title and number only.

Suez

Het Suezkanaal in 1917 (89053 B). W. F. Leemans. 1300 w. Ingenieur—July 13, 1918. Traffic of Suez Canal for 1917. Nationalities and tonnage represented.

Weirs

Permit Weir in St. Lawrence (88987). 2000 w. Can Engr—Sept. 19, 1918. Decision of the International Joint Commission granting permission to the St. Lawrence River Power Co. to build a submerged weir.

Canada Protests Against Weir in St. Lawrence (88659). 2200 w. Can Engr—Sept. 5, 1918. Gives objections set forth.

MARINE AND NAVAL ENGINEERING

Barges

Upper Mississsippi River Barge Fleet (88876 A). Baxter L. Brown. 1200 w. E Cb St L, Jl—July-Aug., 1918. Details of barges and towboats for freight transportation between St. Louis and St. Paul.

Blowers

Installation and Care of Sturtevant VD-5 Turbo-Blower (88972 N). F. W. Sterling. Ills. 1200 w. Am Soc Nav Engrs, Jl—Aug., 1918. Details of alignment, operation, packing, bearings, etc.

Test of Sturtevant Forced Draft Blower (88971 N). M. C. Stuart. Ills. 26 pp. Am Soc Nav Engrs, Jl—Aug., 1918. A test of performance.

Boiler Corrosion

Marine Boiler Corrosion; Causes and Prevention (88831). D. E. Rees, with discussion. 6000 w. Mar Eng, Can—Aug., 1918. Treatment, lubrication effects, effect of air, etc.

Cargo Vessels

The Most Suitable Sizes and Speeds for General Cargo Steamers (88702 A). John Anderson. Read before Instn. Nav. Archts., London. 2500 w. Int Mar Eng—Sept., 1918. Method of determining most economical dimensions.

Concrete Ships

Concrete Ships (88879 A). Harvey S. Owen. 4500 w. E Cb St L, Jl—July-Aug., 1918. As an aid in the solution of trans-Atlantic transportation problem.

How Concrete Ship Was Developed (88560 A). Frank C. Heard. 1500 w. Mar Rev—Sept., 1918. First construction used in rowboat in 1849.

The Design of Concrete Ships (89023 A). H. Devereux. Ills. 6500 w. West Eng—Sept., 1918. Serial, 1st part. General rules based on approved practice. Typical example given.

Developments in Concrete Barges and Ships (88705 A). J. E. Freeman. Read before Am. Concrete Inst. 2500 w. Int Mar Eng—Sept., 1918. Résumé of history of concrete shipbuilding in the United States and Europe.

Concrete Ships (89070). 2500 w. Times Engng Supp—Aug., 1918. Serial, 1st part. British experience, progress made, types of vessels, etc.

Method of Concrete Ship Construction (88704 A). Theodore Ahlborn. Ills. 1100 w. Int Mar Eng—Sept., 1918. Assumptions for producing a design that will take care of all stresses. Methods of construction.

Reinforced Concrete Vessels (88703 A). Walter Pollock. Ills. 3000 w. Int Mar Eng—Sept., 1918. Factors involved in designing small coast-wise concrete motor ships.

Crews

Manning the New Merchant Marine (88701 A). Henry Howard. 2000 w. Int Mar Eng—Sept., 1918. Free schools established for training deck and engine room crews for American ships.

Electrical Equipment

Electrical Applications to Merchant Vessels (88973 N). H. A. Hornor. 4000 w. Am Soc Nav Engrs, Jl—Aug., 1918. Rules and specifications for the installation of electrical equipment, construction, distribution, switchboards, searchlights, etc.

Electric Welding

Electric Welding in Shipbuilding (89069). 1200 w. Times Engng Supp—Aug., 1918. British experience in building rivetless ships.

An Electrically Welded Barge (88608 A). Ills. 700 w. Engng—Aug. 9, 1918. Details of a 120 ft. barge in which no rivets were used, the structure being put together by electric welding. Importance of the method.

Study of Electric Welding Aids in Our Shipbuilding (88649). Comfort A. Adams. 1800 w. Elec Wld—Sept. 7, 1918. Review of report of Capt. James Caldwell of England covering experience and general state of the art.

Application of Electric Welding to Shipbuilding (88864 A). 4500 w. Engng—Aug. 23, 1918. Experiments carried out by Lloyd's Register and the results, with regulations for the application of electric arc welding to ship construction.

Electrically Welded Cargo Ships (88877 A). 2500 w. E Cb St L, Jl—July-Aug., 1918. Review of the problems of welding in their application to marine construction and what is being accomplished by the U. S. Shipping Board Emergency Fleet Corporation.

Electric Arc Welding in Shipbuilding (88856 A). 1500 w. Engr—Aug. 23, 1918. Regulations issued by Lloyd's Register of shipping for the application.

Electric Welding as Applied to Steel Ship Construction (88827 A). Ills. 12 pp. E Cb Phila, Jl—Sept., 1918. Series of discussions held under the auspices of the Electric Welding Branch of the Education and Training Section of the U. S. Shipping Board.

Evolution of Electric Welding Processes as Applied in Shipbuilding (88880 A). H. A. Hornor. 3000 w. E Cb St L. Jl—July-Aug., 1918. Spot welding and arc welding will be methods generally used in ship construction.

Fabricated Ships

Assembling and Regulating Ship's Structure (88706 A). T. L. Cohee. 2000 w. Int Mar Eng—Sept., 1918. Rigid system necessary to eliminate errors in assembling fabricated ships.

Hog Island

Hog Island Yard Has Made Good (88561 A). H. Cole Estep. Ills. 3500 w. Mar Rev—Sept., 1918. Account of the development and work, and the launching of the Quistconck.

Launching

When the Quinstconck Was Launched (88562 A). R. V. Sawhill. Ills. 1800 w. Mar Rev—Sept., 1918. Elaborately illustrated account of the first launching at Hog Island.

Lusitania

Lusitania Suits Dismissed by Court (88519). 3500 w. Naut Gaz—Aug. 31, 1918. German Government held responsible for sinking.

Marine Engines

Marine Engine Evolution (88980). Joseph R. Oldham. 1800 w. Naut Gaz—Sept. 21, 1918. Relative merits of steam high pressure and oil internal combustion engines.

Merchant Fleet

American Ships for Foreign Trade (88700 A). Edward N. Hurley. 1500 w. Int Mar Eng—Sept., 1918. Great merchant fleet will give new opportunities for foreign trade.

Merchant Shipbuilding (89043 A). 3500 w. Engr—Aug. 30, 1918. British shipbuilding during the war; also brief review of foreign shipbuilding.

Nippon

Nippon Yusen Kaisha (88520). 1500 w. Naut Gaz—Aug. 31, 1918. History and development of a famous Japanese shipping company.

Pacific Mail

Pacific Mail's Early History (88651). Ills. 1200 w. Naut Gaz—Sept. 7, 1918. Wooden paddle steamers built as late as 1870.

Passenger Steamer

Twin-Screw Passenger Steamer "Stavangerfjord" (88846 A). Ills. & Plate. 1200 w. Engng—Aug. 16, 1918. Serial, 1st part. Detailed description of first-class steamer recently completed at Christiana, Norway.

Propellers

Design of Water Propellers by the Specific Speed Method (88976 N). Charles F. Gross. 1500 w. Am Soc Nav Engrs, Jl—Aug., 1918. Shows how this method may be applied to water propeller problems.

Reconstruction

Old Whaleback Barges Transformed (88978). Leon M. Huggins. 1500 w. Naut Gaz—Sept. 21, 1918. Their reconstruction into modern oil carriers.

Riveters

Riveters (88887 B). 1800 w. Cas Eng Mthly—Aug., 1918. On the shortage of riveters and the remedy for the same.

Shipbuilding

Bay State's Merchant Ship Production (88896). 1500 w. Naut Gaz—Sept. 14, 1918. Output now larger than any past time.

Control of Hull Construction of 5,000-Ton Deadweight Fabricated Steel Vessel (88707 A). 1000 w. Int Mar Eng—Sept., 1918. Serial, 1st part. System at yard where straight work was produced at outside shops and furnaced work at yard.

Oak Steamer Built for U. S. Completed on Great Lakes (88563 A). Fred B. Jacobs. Ills. 1300 w. Mar Rev—Sept., 1918. A cargo-carrier designed for overseas service.

Lord Pirrie on British Shipbuilding Prospects (88979). Ills. 1700 w. Naut Gaz—Sept. 21, 1918. Improvement effected by standardizing vessel construction.

Shipbuilding Prospects (88848 A). 2000 w. Engng—Aug. 16, 1918. Editorial on shipbuilding in England, and information concerning the losses by war and related topics.

Steel Uprights for Shipbuilding Berths (88621 A). Ills. 700 w. Engr—Aug. 9, 1918. Improved staging and its advantages.

Shipping

German View of Law of Angary (88897). Charles Henry Hubert and Richard King. 1500 w. Naut Gaz—Sept. 14, 1918. Summarizes existing German law.

Shipyards
Look Shipyard Problems in the Face (89133 A). 600 w. Ind Man—Oct., 1918. Editorial criticism of the management of the yards.

Submarine Chasers
Manufacturing Eagles at Ford Shipyard (88935 A). Charles Lundberg. Ills. 2500 w. Iron Age—Sept. 19, 1918. Details of plant and methods used.

Torpedoes
Early History of the Marine Torpedo (88633 A). H. H. Manchester. Ills. 2000 w. Am Mach—Sept. 5, 1918. The prototype of the torpedo described.

MINING AND METALLURGY

BASE METALLURGY

Copper
See Jerome, under Mines and Districts.

Metallography
Metallography Applied to Nonferrous Metals—I (88570). Ernest J. Davis. Ills. 2500 w. Fndry—Sept., 1918. Serial, 1st part. Deals with the science that embraces a study of the internal structure of metals.

Waste Metal
La Récupération Et L'Utilisation (89083 B). P. Razous. Ills. 4000 w. Génie Civil—Aug. 31, 1918. Serial, 1st part. Recovery and utilization of waste of copper, zinc, tin, lead, aluminum and their alloys. Processes and machines.

COAL AND COKE

Afforestation
Afforestation and Coal Mining (88867 A). 2200 W. Colly Gdn—Aug. 30, 1918. The pressing need of Government action in the afforestation of Great Britain, with suggestions.

Air Compressor
Turbo Air Compressor at the Holbrook Colliery (88618 A). Ills. 2000 w. Engr—Aug. 9, 1918. Details of plant recently erected at Birmingham, Eng.

Ammonia
Ammonia From Coal (89072). 2200 w. Times Engng Supp—Aug., 1918. "Direct" methods of recovery as practiced in Great Britain.

Belgium
Coal and Coke in Belgium Before and After the War (89102 A). 3000 w. Ir & Cl Trds Rev—Sept. 6, 1918. Abstract translation of article by Georges Didier, in *La Revue Belge* on the coal output and trade before the war and suggested means for ousting the German coal after the war.

Blackdamp
The Origin of Blackdamp (88883 N). J. Ivon Graham, with discussion. 18 pp. Instn Min Engrs, Trans—Aug.-Sept., 1918. Composition of black damp and sources of the carbon dioxide and nitrogen.

Canadian Fuels
Fuels of Western Canada (88805). James White. 1700 w. Can Engr—Sept. 12, 1918. Excerpts from paper read before Eng. Inst. of Canada. Coal, natural gas, petroleum, electricity, peat and wood.

Coal
Le Nouvean Bassin Houiller De Lyon (89064 B). A. Pawlowski. 3100 w. La Nature—Aug. 24, 1918. Results of exploration in coal fields near the Rhone.

The Scarcity and Cost of Coal (88847 A). 2000 w. Engng—Aug. 16, 1918. Editorial discussion of conditions and outlook in Great Britain.

Coalfield Developments and Extensions (88861 A). Maps. 2500 w. Ir & Cl Trds Rev—Aug. 23, 1918. Information from report of Geological Sub-committee, and included in final report of Coal Conservation Committee. On possible extensions of Coalfields in Great Britain.

The Future of Coal Using (88591 A). W. H. Booth. 1200 w. Elec Rev—Aug. 9, 1918. Discusses points in the Interim Report of the Reconstruction Committee dealing with the power question and saving of waste heat.

The Waterlogged Coal Area in South Staffordshire (88868 A). 1500 w. Colly Gdn—Aug. 30, 1918. Note from the Final Report of the Mining Sub-committee. Account of British districts waterlogged and matters relating to recovery of coal.

Coal Distillation
Low-temperature Distillation of Illinois and Indiana Coals (88772 D). G. W. Traer. 7 pp. A I M E, Bul—Sept., 1918. Details of a Chicago experimental plant and its operation and results.

Coal Prices
Method of Fixing Prices of Bituminous Coal Adopted by the United States Fuel Administration (88770 D). Cyrus Garnsey, Jr., R. V. Norris, and J. H. Allport. Map. 22 pp. A I M E, Bul—Sept., 1918. Explains methods, discussing their advantages and disadvantages.

Coal Production
Loss and Waste in Coal Production (89047 A). 10500 w. Ir & Cl Trds Rev—Aug. 30, 1918. From final report of the Coal Conservation Committee. Gives sub-committee report considering improvements that can be effected in methods of mining coal with a view to prevent loss and minimize cost.

Coal Tar
Methods of Analysis Used in the Coal-Tar Industry—I. Crude Tars (88699 B). J. M. Weiss. Ills. 5000 w. Jl Ind & Eng

Coke
Metallurgical Coke and the Recovery of By-Products (89046 A). Report by W. A. Bone. Appendix I to the Report of the Carbonization Committee. 3000 w. Colly Gdn—Sept. 6, 1918. Recent important developments in by-product coking practice, and related topics.

Conservation
Coal Conservation Committee. Final Report (88767 A). Also editorial. Map. 9000 w. Colly Gdn—Aug. 23, 1918. Serial, 1st part. Committee appointed to consider possible improvements in mining and utilization of new coal fields.

Deep Borings
Deep Borings for Coal (88769 A). 1500 w. Colly Gdn—Aug. 23, 1918. The Market Weighton and Kelham borings in Great Britain.

Electrification
The Electrification of a Durham Colliery (88851 A). Ills. 2000 w. Engr—Aug. 16, 1918. Serial, 1st part. Detailed description of the Blackhall colliery in which the whole of the machinery is driven electrically.

Gaseous Mines
Outbursts of Gas in Crowsnest Field (88639). James Ashworth. Abstract of pamphlet relating to this coalfield of British Columbia. Ills. 3500 w. Cl Age—Sept. 5, 1918. Describes violent gas outbursts which, with other causes, have closed the mines.

Germany
Mineral Wealth of Germany (89060 A). H. Louis. 1400 w. Nature—July 4, 1918. Abstract of article in June, 1918, issue of *Fortnightly Review* on coal and iron.

Lignite
Lignite—Fuel Saver (88612). H. S. Cooper. 1800 w. Mfrs Rec—Sept. 5, 1918. The advantages and disadvantages, its qualities, applications, economical combustion, etc.

Mine Inspection
Coal Mines Inspection in 1917 (88605 A). 9000 w. Colly Gdn—Aug. 16, 1918. Reports from various divisions of Great Britain and Ireland.

Powdered Coal
A Diversified Application of Powdered Coal (88753 A). Charles Longnecker. Ills. 1300 w. Iron Age—Sept. 12, 1918. Distributed by compressed air to sub-stations and used in open-hearth, annealing and other furnaces.

Russia
See same heading under Iron and Steel.

Spontaneous Combustion
The Flow of Air Through Small Coal and Other Broken Material: Report to the Doncaster Coal Owners' Committee (88884 N). John T. Storrow, with discussion. Ills. 10 pp. Instn Min Engrs, Trans—Aug.-Sept., 1918. Investigations and results.

Superheat
The Value of Superheated Steam at the Colliery and at Ironworks (89101 A). Ills. 1200 w. Ir & Cl Trds Rev—Aug. 30, 1918. Explains advantages and gives details of the "Sugden" superheater.

Supply
Coal Shortage (88872 N). F. W. Gray. 2000 w. Can Min Inst, Bul—Sept., 1918. The urgency of increased production and its importance in winning the war.

GEOLOGY

Gold and Silver
Geologische arbeidsmethoden voor de opsporing van delfstofafzettingen (89051 B). E. C. Abendanon. 3200 w. Ingenieur—July 6, 1918. Geological methods of prospecting for gold and silver.

IRON AND STEEL

Briey Iron Mines
Iron Mines Which Allies May Capture (88936 A). Map. 2000 w. Iron Age—Sept. 19, 1918. The French-Lorraine mines of the Briey district, seized by Germany in 1914, may be captured.

Briquetting
Le Briquettage Des Minerais De Fer Pulverulents (89081 B). Ills. 4200 w. Génie Civil—Aug. 17, 1918. Serial, 2d part. Processes for briquetting iron-bearing minerals and blast furnace dust.

By-Products
By-product Recovery in Iron and Steel Works (88866 A). 2200 w. Engng—Aug. 23, 1918. Editorial review of subjects dealt with in a paper by A. Gouvy dealing with the recovery and utilization of by-products.

Electric Furnace
The Electric Furnace in the Steel Casting Industry (89010 A). W. E. Moore. 2000 w. Elec Jl—Sept., 1918. Former methods of producing steel are reviewed and the quality produced in the electric furnace and other advantages.

Fuel Economy

Fuel Economy in Modern Steel Works Unit (88862 A). 3000 w. Ir & Cl Trds Rev—Aug. 23, 1918. From report by Benjamin Talbot, published as Appendix to Coal Conservation Committee's report.

Furnace Doors

Automatic Door Hoists for Open Hearth Furnaces (88944 N). W. H. Burr and H. A. Lewis. Ills. 2000 w. Assn I S E E—May, 1918. Describes equipment involving a new idea.

Germany

See same heading under Coal and Coke.

Iron Ore

Notes on Certain Iron-ore Resources of the World (88773 D). E. C. Harder, W. Lindgren, C. M. Weld, A. C. Spencer, H. F. Bain, Sidney Paige. 25 pp. A I M E, Bul—Sept., 1918. Notes on Brazil, Scandinavia, Cuba, Europe, China and Alsace-Lorraine.

Microstructure

On the Microstructure of Certain Titanic Iron Ores (89106 B). Charles H. Warren. Ills. 24 pp. Ec-Geol—Sept., 1918. A microscopic study.

Production

A German View of Post-War Iron and Steel Production (88860 A). Dr. A. Birchlager, in *Deut. Berg. Zeit.* 1500 w. Ir & Cl Trds Rev—Aug. 16, 1918. Discusses the prospects in the export markets after the conclusion of peace.

Queensland

Proposed Iron and Steel Works in Queensland (88766 N). 3500 w. Qnsd Gov Min Jl—July 15, 1918. Report of the Royal Commission.

Russia

Iron and Coal in Russia Before the War (88858 A). From paper by Alexandre Gouvy. Ills. 5000 w. Ir & Cl Trds Rev—Aug. 16, 1918. The resources and future prospects are discussed.

Steel

The Making of Steel in America (88836 N). W. J. Grasswick. Ills. 3500 w. Comwh Engr—Aug., 1918. Abstract of paper before Victorian Inst. of Engrs. Details of processes.

Steel Works

The Slick Wheel Mill (88477 A). Ills. 3500 w. Iron Age—Aug. 29, 1918. Commercial products formed directly from large rolled bars by rolling forging process at Cambria Steel Works.

MINE OPERATION

Blasting

Chamber Blasting Methods and Costs (88933). E. E. Baker, in *Min. & Sci. Pr.* (Abstract.) 5000 w. Eng & Con—Sept. 18, 1918. On blasting for steam shovel work in mining operations. Method at Chuquicamata, Chili.

Some Notes on Experiments Made With a View to Reducing the Consumption of Explosives, and Increasing the Fathoms Broken per Machine Shift in Machine Stoping (88693 N). T. H. Bayldon. 3000 w. So Af Instn Engrs, Jl—July, 1918. Details of experiments.

Cementation Process

Cementation Process Applied to Mining (François System) (88587 N). A. H. Krynauw, with short discussion. Ills. 12 pp. Chem, Met & Min Soc S Af, Jl—May, 1918. Details of the process and its successful applications.

Coal Economy

Coal Economy in Mine Boiler Firing (88965 A). Ills. 1000 w. Eng & Min Jl—Sept. 21, 1918. Method of using a carbon dioxide recorder for controlling the composition of flue gases from large steam boilers.

Drilling

Mechanical Equipment and the Conservation of Miners (88900). R. L. Herrick. Ills. 2500 w. Com Air Mag—Sept., 1918. Examples of man-power saving observed in the anthracite district.

Machine Mining

Machine Mining at La Salle, Illinois (89019). George W. Harris. Ills. 1200 w. Cl Age—Sept. 19, 1918. Longwall machine mining in thin-vein fields.

Mine Locomotives

Advantages of Storage-Battery Locomotives (88638). C. W. Chappelle, with discussion. Read before Illinois Min. Inst. Ills. 6500 w. Cl Age—Sept. 5, 1918. Merits as applied to the gathering of coal in mines.

A New Type of Mine Locomotive Controller (88679 A). L. W. Webb. Ills. 900 w. Gen Elec Rev—Sept., 1918. Developed for service on large mine locomotives.

Determination of the Proper Size of Storage-Battery Locomotive (89022). Dever C. Ashmead. 2200 w. Cl Age—Sept. 19, 1918. Drawbar pull and battery capacity govern the selection. Method of determining these factors explained.

Mine Power

Mining Electrical Engineering (88592 A). Chris. Jones. Abstract of article in Pro. S. Wales Inst. of Engrs. Ills. 2500 w. Elec Rev—Aug. 9, 1918. Serial, 1st part. A consideration of the electrical system.

Ore Car

Ore Car Designed at Hecla Mine (88962 A). C. T. Rice. Ills. 1800 w. Eng & Min Jl—Sept. 21, 1918. Construction details of a mine car of 82 cu. ft. capacity.

Pillars

Method of Mining Pillars at the Fortuna Mine of the Braden Copper Co., Chile (88797 A). Charles Hollister. Ills. 1200 w. Eng & Min Jl—Sept. 14, 1918. Methods of breaking and supporting the ground.

Shaft Pillars

Notes on the Removal of a Vertical Shaft Pillar (88589 N). J. Chilton, with remarks. Ills. 3000 w. Chem, Met & Min Soc S Af, Jl—June, 1918. Discussion of the problem, with explanation.

Substation

Large Underground Synchronous Substation (88637). R. P. Hines. Ills. 1500 w. Cl Age—Sept. 5, 1918. A transforming and converting station underground which has given satisfaction.

Timbering

Timbering in Mines (88857 A). S. Evans, with discussion. Paper at Midland Branch of the N. A. C. M. Ills. 4500 w. Ir & Cl Trds Rev—Aug. 16, 1918. Methods for preserving and protecting timber in mines as it is scarce and expensive.

Tipples

Simpson Creek Coal Co.'s Tipples (88636). R. G. Read. Ills. 1100 w. Cl Age—Sept. 5, 1918. Novel features in the design. Coal coming down the mountain side generates power.

Tunnels

Tunnel-Blasting at Chuquicamata (89025 A). E. E. Barker. Ills. 4500 w. West Eng—Sept., 1918. Tunnels are driven under a bank 150 ft. high and loaded with dynamite and black powder. Results and cost.

MINES AND DISTRICTS

Colorado

Mining in the Telluride District of Colorado (88523 A). Harry J. Wolf. Ills. 3500 w. Eng & Min Jl—Aug. 31, 1918. Brief history, climatic conditions, class of deposits, and mining characteristics.

Jerome

Petrographic Notes on the Ore Deposits of Jerome, Ariz. (88774 D). Marion Rice. Ills. 6 pp. A I M E, Bul—Sept., 1918. Notes on this important copper-mining district.

Mine Conditions

Earth Movements and Underground Conditions in Mines (88718 N). A. Montgomery. 7000 w. Cham Mines W Aust, Mthly Jl—May 31, 1918. State mining engineer's report on general conditions of underground work in Australia.

Nova Scotia

Nova Scotia Production and Its Relation to the War (88874 N). F. E. Lucas. 1500 w. Can Min Inst, Bul—Sept., 1918. The materials contributed for war purposes, and the value of raw materials.

Quebec

Report on Mining Operations in the Province of Quebec During the Year 1917 (88709 N). Maps & Ills. 140 pp. Dept. Colonization, Mines & Fisheries—1918. Statistical tables and review.

MINOR MINERALS

Aluminum

Aluminum (Bauxite) Deposits and the Production of Aluminium (88844 A). 4500 w. Engng—Aug. 16, 1918. Serial, 1st part. A survey of known deposits and descriptions of the present development of processes of production.

Contributions to the Chemistry of Aluminium and Aluminium Alloys (88947 N). John G. A. Rhodin. 4400 w. Faraday Soc—July 23, 1918. A method of directly determining aluminium.

Metallography of Aluminium: Recrystallization and Grain-Growth—The Result of Deformation in the Cold Prior to Annealing (88948 N). Robert J. Anderson. Ills. 1500 w. Faraday Soc—July 23, 1918. Description of tests made on the annealing of cold-rolled aluminium sheet.

Canada

Mineral Springs of Canada (88710 N). R. T. Elworthy. Ills. Part II. 165 pp. Can Dept Mines—Bul. No. 20. The chemical character of the waters.

Clay

Clay Resources of Southern Saskatchewan (88806). 1500 w. Can Engr—Sept. 12, 1918. Abundance of high-grade clays suitable for manufacture of stoneware, Rockingham wear, and white earthenware.

Colorado

War Minerals of Colorado (88521 A). A. H. Hubbell. 2500 w. Eng & Min Jl—Aug. 31, 1918. Important producer of the major metals, and for the output of tungsten and radium minerals.

Manganese

Manganese (88711 N). M. A. Allen and G. M. Butler. 30 pp. Univ Ariz, Bul. 91—Aug., 1918. Information concerning manganese and its ores.

Manganese Deposits of East Tennessee (88910 N). G. W. Stose and F. C. Schrader. Ills. & Maps. 55 pp. Resources Tenn—July, 1918. Report of field work by geologists giving known deposits and descriptions of typical mines with suggestions.

Molybdenite

Simpson's Molybdenite Find (88765 N). Lionel C. Ball. Ills. 1800 w. Qnsd Gov Min Jl—July 15, 1918. In the Connors Range, near Cardowan, Central Queensland.

Potash

Potash and Other Mineral Developments As Viewed by War Industries Board (88776). 2500 w. Mfrs Rec—Sept. 12, 1918. Letters from Bernard M. Baruch, T. Poole Maynard, and Charles Catlett, with remarks.

Potash as It Relates to War and Peace (88949). 2500 w. Mfrs Rec—Sept. 19, 1918. The importance of potash and of the development of the potash industry in the United States.

The Cottrell Processes of Electric Precipitation, with Especial Regard to Their Application to the Recovery of Potash as a By-Product (88952). J. S. Grasty. 5500 w. Mfrs Rec—Sept. 19, 1918. Salient features of the precipitation processes, the uses to which they have been applied, especially the recovery of potash.

The Potash-Bearing States of Georgia (88953). T. Poole Maynard. Ills. 1600 w. Mfrs Rec—Sept. 19, 1918. History and information concerning these deposits.

Quicksilver

The Position of the Quicksilver Producers in California (88656 A). 3500 w. Eng & Min Jl—Sept. 7, 1918. Statement of past and present difficulties. A plea is made for a protective tariff of $35 per flask.

Salt

Intrusive Origin of the Gulf Coast Salt Domes (89107 B). G. Sherburne Rogers. Ills. 38 pp. Ec-Geol—Sept., 1918. Reviews earlier theories and discusses the applicability of a tectonic theory to the American domes.

Salt Mining and Dressing (88654 A). J. B. Calkins. Ills. 2500 w. Eng & Min Jl—Sept. 7, 1918. Brief history of the salt industry in America, describing modern mining methods and preparation for market.

OIL AND GAS

Fuel Oil

Home Sources of Fuel Oil (88622 A). 5000 w. Ir & Cl Trds Rev—Aug. 9, 1918. Two official Committee reports dealing with this question.

War Status of Gasoline and Fuel Oil (88825 A). John D. Gill. Ills. 5000 w. E Cb Phila, Jl—Sept., 1918. Explains the character and uses of gasoline and fuel oil; the present supply; substitutes, etc.

Oil Fields

The Glenmary Oil Field (88911 N). L. C. Glenn. 9 pp. Resources Tenn—July, 1918. Information concerning oil wells.

Oil Shales

Will Shales Give Us Oil and Gasoline in Practically Unlimited Supply? (88611). 3000 w. Mfrs Rec—Sept. 5, 1918. Important aspects of the problem of making available these natural resources.

Petroleum

Unmined Petroleum Supply Limited (88982). Allen Sinsheimer. Ills. 1500 w. Auto Ind—Sept. 19, 1918. Estimated at 70 barrels per person in the United States.

South America

The Economic and Geologic Conditions Pertaining to the Occurrence of Oil in the North Argentine-Bolivian Field of South America (88775 D). Stanley C. Herold. Ills. 20. pp. A I M E, Bul—Sept., 1918. Describes this region and its development.

ORE DRESSING

Cyaniding

The Estimation of Oxygen in Working Cyanide Solutions (88588 N). H. A. White, with discussion. 3500 w. Chem, Met, & Min Soc S Af, Jl—June, 1918. Explains a new colorimetric method.

Flotation

Differential Flotation of Lead-Zinc Tailing at a Small Plant (88964 A). 1000 w. Eng & Min Jl—Sept. 21, 1918. Describing treatment of tailings containing lead and zinc sulphides.

Differential Flotation at Wallace, Idaho (88799 A). C. T. Rice. Ills. 900 w. Eng & Min Jl—Sept. 14, 1918. Treatment of zinc-lead sulphide ores.

Litigation

Similarities in the Legal Aspects of Some Flotation, Cyanidation, and Filtration Litigation (88875 N). R. C. Canby. 3500 w. Can Min Inst, Bul—Sept., 1918. Compares the McArthur-Forrest cynaide and the Moore filter cases with features of present flotation litigation.

Ore Treatment

Ore Treatment in Colorado (88522 A). Map. 2500 w. Eng & Min Jl—Aug. 31, 1918. Its position in the milling and metallurgical field.

Recovery

Recovery of Selenium and Tellurium in Copper Refining (88657 A). M. H. Merriss and H. T. Binder. 2200 w. Eng & Min Jl—Sept. 7, 1918. Methods of recovery from electrolytic slime are suggested as practicable.

Screening

Mechanical Screening of Wet Pulp (88963 A). H. E. Megraw. 2000 w. Eng & Min Jl—Sept. 21, 1918. Mechanical screening as a preliminary to concentration is recommended. Features of apparatus discussed.

Smeltery

The Blast-Furnace Charge at the Bunker Hill Smeltery (88655 A). C. T. Rice. Second article of a series. Ills. 1500 w. Eng & Min Jl—Sept. 7, 1918. Describes the composition of the charge and the handling of the various materials comprising it.

PRECIOUS METALLURGY

Diamonds

The Discovery of Diamonds in South Africa (88714 A). E. J. Dunn. 6000 w. Aust Min Std—July 18, 1918. Account of the discovery.

Gold Mining

Gold Mining Disabilities (88717 N). 7500 w. Cham Mines W Aust, Mthly Jl—May 31, 1918. How war conditions and increased taxation have increased the disabilities of this industry so important for Australia.

Pyrite

Pyrite Mining at Kershaw, South Carolina (88961 A). Joel H. Watkins. Ills. 3500 w. Eng & Min Jl—Sept. 21, 1918. The old Haile gold mine being worked for production of pyrite ore.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

France

Operation the U. S. Military Railways in France (88942). J. G. Porter. Ills. 3500 w. Ry Age—Sept. 20, 1918. How Americans adapted themselves to conditions encountered.

N. W. Region

N. W. Region; A Group of Well-Managed Roads (88813). Photographs. 2500 w. Ry Age—Sept. 13, 1918. Ranks high in earning capacity and operating efficiency.

Signaling

Signaling Practice (88998 C). Ills. 60 pp. Ry Sig Assn, Jl—Sept., 1918. Reports of committees on mechanical interlocking, standard designs, A. C. automatic block signaling, signaling practice, etc.

Troop Trains

A Novel Scheme for Carrying Troops by Rail (88815). Frederick C. Coleman. Ills. 1500 w. Ry Age—Sept. 13, 1918. Military cars used by the Indian Peninsula Ry. are described.

U. S. Administration

Organization of Government Railroad Administration (88784 A). 2000 w. Eng News-Rec—Sept. 12, 1918. Chart and explanatory data.

Director General McAdoo Reports to the President (88812). 6000 w. Ry Age—Sept. 13, 1918. Work of the U. S. railroad administration for the first seven months.

MOTIVE POWER AND EQUIPMENT

Cars

Steel Baggage Car for the United States Railroad Administration (88668). 1000 w. Ry Rev—Sept. 7, 1918. General description of design for all-steel 70-foot baggage car.

Electric Locomotives

Torque of Electric Motors as Applied to Electric Locomotives (88678 A). 1500 w. Ry & Loc Eng—Sept., 1918. Shows characteristic curves, telling how to read them and how to apply them to a locomotive.

New Single-Phase Locomotives for the Swiss Bundesbahn (88666). Hugo Studer. Ills. 1500 w. Elec Ry Jl—Sept. 7, 1918. Details of four sample locomotives ordered.

Regenerative Electric Railways (88593 A). 2000 w. Elec Rev—Aug. 16, 1918. The economy of the regenerative system and its adoption on 3-phase, single-phase, and d. c. railways.

Feed-Water Heaters

The History of Locomotive Feed Water Heaters (88674 A). J. Snowden Bell. Ills. 4400 w. Ry & Loc Eng—Sept., 1918. Salient features of an exhaustive paper.

Fire-boxes

Renewable Stay Heads for Locomotive Fireboxes (89044 A). Ills. 2500 w. Engr—Aug. 30, 1918. A patent device for renewing small or defective stay heads and its advantages.

Fuel Conservation

The Railroad Fuel Conservation Campaign (88999). Eugene McAuliffe. 2000 w. Ry Rev—Sept. 21, 1918. True statement of the situation, and the extreme need for improvement. How railways may improve conditions.

Locomotive Development

The Advance of Science Applied to Locomotives in the Last Eighteen Years (88676 A). 1700 w. Ry & Loc Eng—Sept., 1918. Review of progress.

Locomotives

The U. S. Standard Heavy Mikado Type Locomotive (88516). Ills. 1200 w. Ry Age—Aug. 30, 1918. Recently completed by Am. Locomotive Co. Second of standard types to be placed in service.

The First Standard 0-8-0 Type Switching Locomotive (88941). 600 w. Ry Age—Sept. 20, 1918. Total weight 214,000 lb.; tractive effort 55,000 lb.

4 Cilinder Compound-locomotieven voor Java (89055 B). I. Franco. Ills. 5900 w. Ingenieur—July 20, 1918. 4 Cylinder compound, 4-6-2 type, with feed-water heater built for Dutch railways in Java.

Pulverized Coal

Pulverized Coal on American Locomotives (88855 A). Ills. 2000 w. Engr—Aug. 23, 1918. Serial, 1st part. Reviews the history of its use in the U. S.

Smoke Prevention

Locomotive Stokers and Smoke Prevention (88643). W. S. Bartholomew. Abstract of paper before Smoke Prevention Assn. 2500 w. Ry Age—Sept. 6, 1918. With careful firing lighter fires can be carried with more perfect combustion.

Valve Setting

Practical Hints on Valve Setting (88675 A). Ills. 1800 w. Ry & Loc Eng—Sept., 1918. Correction of errors.

PERMANENT WAY AND BUILDINGS

Rail Fissures

Transverse Rail Fissures and the Derailment at Juniper, Ga. (88530). Ills. Also editorial. 3200 w. Ry Rev—Aug. 31, 1918. From report of James E. Howard on investigations made.

ROADS AND PROJECTS

French Lines

Restauration Des Chemins De Fer Après La Guerre (89085 B). H. Morissat. Ills. 2000 w. La Nature—Sept. 7, 1918.

Cstia

See same heading under Civil Engineering, *Waterways and Harbors.*

U. S. Railroads

The Immediate Needs of the Railroads (87807 A). 2500 w. Eng News-Rec—July 25, 1918. Improvements needed to avoid congestion next winter.

Valuatino

I. C. C. Report on Valuation of Texas Midland (88517). 600 w. Ry Age—Aug. 30, 1918. Renders decision on carrier's objections to tentative finding.

TRAFFIC

Government Control

Meeting of the National Industrial Traffic League (88644). 3000 w. Ry Age—Sept. 6, 1918. How the large shippers feel toward the new management of the railroads.

Package Freight

Conveyor Scheme for Handling New York City's Package Freight (88645). Ills. 1000 w. Ry Age—Sept. 6, 1918. Abstract of paper by M. A. Long outlining a plan for constructing three tunnels under the Hudson river for vehicular traffic with conveyors on each side of each tube to transport l. c. l. freight.

Private Car Lines

Private Car Lines to Receive One Cent a Mile (88518). 8000 w. Ry Age—Aug. 30, 1918. Interstate Commerce Commission finds this rate necessary to help compensate for increased cost.

Southwest

Organization of the Southwestern Railway Region (88101). 2000 w. Ry Age—Aug. 9, 1918. Economic character of the territory; mileage, equipment, and revenues of the railways.

Transport

Transport Reform Considerations (89100 A). Granville F. Billbrough. 3500 w. Ir & Cl Trds Rev—Aug. 30, 1918. Serial, 1st part. Aims to indicate lines for securing a more general coöperation and to outline methods which might improve facilities and secure economies in transportation.

United Kingdom

Coal and Mineral Traffic on the Railways of the United Kingdom (89048 A). H. Kelway-Bamber, with discussion. Abstract of paper before Instn. of Locomotive Engrs. 4500 w. Ir & Cl Trds Rev—Aug. 30, 1918. Compares the relative efficiency of coal-carrying wagons, discussing possible improvements.

STREET AND ELECTRIC RAILWAYS

Armature Heating

Armature Heating in Traction Motors (88840 A). Dr. L. Adler. Abstract from *Elektro. Zeit.* 2000 w. Elec'n—Aug. 9, 1918. Methods of determining the temperature and the results.

Armatures

Rewinding and Testing Direct-Current Locomotive Armatures (89020). Frank Huskinson. Ills. 2000 w. Cl Age—Sept. 19, 1918. Methods and "stunts" resorted to by a practical mine electrician.

Buffalo-Niagara

Quick Service Between Buffalo and Niagara Falls (88106). Ills. 1200 w. Elec Ry Jl—Aug. 10, 1918. Salient features of a high-speed line.

Cars

Large Capacity Wooden Hopper Car (88687 A). Ills. 1200 w. Ry Mech Engr—Sept., 1918. Details of car for the Norfolk & Western.

Car Trucks

Forces Acting Directly or Indirectly Upon the Truck Side Frame (88275). Norman Litchfield. 2500 w. Elec Ry Jl—Aug. 17, 1918. Factors which affect side frame design.

Checking Devices

Study of Car Energy Saving at Dubuque (88351). L. E. Gould. Map. 1500 w. Elec Ry Jl—Aug. 24, 1918. Tests made on level and hill lines showing savings obtained by use of meters as checking devices.

Construction

Electric Railway Construction on the Detroit-Superior Bridge (87850). Ills. 800 w. Elec Ry Jl—July 27, 1918. Interesting overhead and track work on the high-level viaduct at Cleveland, Ohio.

Coöperation

Philadelphia Coöperative Plan Extended (88817). 3000 w. Elec Ry Jl—Sept. 14, 1918. Success of plan shown by eight years of experience. Several changes made in new plan.

Cost-of-Service

Defects in the Cleveland Plan (88729 A). Andrew Squire. 3000 w. A E R A—Aug., 1918. Faults which eight years of operation under cost-of-service system have developed.

Electric Locomotives

See same heading under Railway Engineering, *Motive Power and Equipment.*

Employees

Labor and the Electric Railways (88546). Britton I. Budd. 2200 w. Elec Ry Jl—Aug. 31, 1918. Importance of coöperation and fair pay.

Fares

How Zone Fares Are Collected (88545). 2500 w. Elec Ry Jl—Aug. 31, 1918. Summary of European and American practice showing methods adopted.

Gear Losses

Will a Cushioned Gear Save Power in Car Operation? (88276). G. W. Remington. 1000 w. Elec Ry Jl—Aug. 17, 1918. Energy expended in vibration and shocks is improperly included with the gear losses.

Line Construction

Applying Common-Sense in Line Construction (88273). Charles R. Harte. Ills. 3000 w. Elec Ry Jl—Aug. 17, 1918. Money and time can be saved by close co-operation of designer and constructor.

One-Man Cars

A. E. R. A. War Board Submits Brief on One-Man Cars (88033). 3000 w. Elec Ry Jl—Aug. 3, 1918. Favorable report.

Operation

Increased Economy Results from Correct Operation of Car Equipment (88272). C. W. Squier. 1500 w. Elec Ry Jl—Aug. 17, 1918. Effects of rate of acceleration and braking on the schedule speeds and power consumed in car operation.

Passenger Transportation

Putting Car Wheels Under Shipbuilders ([illegible]). Ills. [illegible] w. Elec Ry Jl—Aug. 3, 1918. Service reported adequate in 85 out of 164 shipyards.

Power Saving

Conserving Men and Material (88730 A). 2500 w. A E R A—Aug., 1918. Recommendations of street railway committee of the New England Fuel Administration.

Rates

Automatic Rate System Is Fair to All (88107). Harold W. Clapp. 2000 w. Elec Ry Jl—Aug. 10, 1918. Shows desirability of flexible fares automatically adjusted.

Reclamation Work

Connecticut Company Centralizes Reclamation Work at New Haven (88543). Ills. 2000 w. Elec Ry Jl—Aug. 31, 1918. Economies from reclaiming equipment.

Service

Hauling Shipbuilders to Hog Island—and Home Again (88816). Ills. 2500 w. Elec Ry Jl—Sept. 14, 1918. Problems in transferring 30,000 people each way daily.

High Passenger Density the Outstanding Feature of New Service to Hog Island (88665). Ills. 2500 w. Elec Ry Jl—Sept. 7, 1918. Cars for carrying shipbuilders are described, also the service.

Slowdowns

The Time Lost in Slowdowns (88686 A). Walter V. Turner. 2500 w. Ry Mech Engr—Sept., 1918. Compares acceleration with deceleration in steam road service, computing time lost.

Snow

Snow Fighting in Montreal (88544). Arthur Gaboury. 2500 w. Elec Ry Jl—Aug. 31, 1918. How a northern city keeps its streets clear of snow in severe winters, and maintains car service.

Sweden

On Visiting the Riksgrans Railway (87943 A). H. L. Kirker. Ills. 3500 w. Elec Jl—Aug., 1918. Single-phase railway in the Arctic Circle, in Lapland, Northern Sweden.

Tower Erection

Some Practical Points in Pole and Tower Erection and Support (88991). Charles R. Harte. Ills. 4500 w. Elec Ry Jl—Sept. 21, 1918. Particular reference to erection in marshy ground.

Tracks

Subsoil and Its Important Relation to Track Construction (88992). R. C. Cram. Ills. 2500 w. Elec Ry Jl—Sept. 21, 1918. Analyzes track development since the beginning of electric railway operation.

Track Work

Special Track Work for Street Railways (88323 A). J. V. Hunter. Ills. 2500 w. Am Mach—Aug. 22, 1918. Methods used in manufacture of switches, frogs and crossovers.

INDUSTRIAL MANAGEMENT
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Salvaging and Utilizing Wastes and Scrap in Industry

By W. Rockwood Conover

Reclaiming industrial materials and wastes and applying them to the needs of production demands energetic managerial action. We cannot afford to lose from essential production an ounce of metal or fibre, a drop of oil, acid or chemical, nor a particle of leather, rubber, paper, wood or coal. The significance of this salvaging is forcibly presented in this article, and reclaiming practice is outlined for a number of classes of materials and wastes.

Mr. W. Rockwood Conover has been connected with the General Electric Company for the past twenty-seven years, and for the major portion of that time has devoted his attention to economics and conservation work. For the past sixteen years he has been economist at the Schenectady plant. He is the author of two historical volumes, also of numerous papers on organization and efficiency, and is a frequent contributor to the technical press on industrial economics.

A NEW interest has been awakened in the subject of salvaging wastes which is obviously the direct result of the war. Conservation in industry has within the brief space of less than two years become a world-wide slogan. The world is fast becoming aroused to the facts, that savings is now one of the chief, vital principles of existence; that the extravagant, wasteful practices of the past mean ruin to the nation continuing them; that the winning of the present conflict depends, and has depended, not so much upon guns and men, not so much upon equipment in the field, as upon the careful saving and judicious use of every fabric and fibre, of every piece of metal, and of every element of human and mechanical energy, which go to make up and sustain the modern gigantic machinery of war.

In industry these words have assumed a new and more vital significance for us since America's entrance into the world struggle. Saving and utilizing the by-products of production have gained a new and sudden prominence among other established practices of recognized value in engineering and manufacturing. The government now demands to know what we are doing with the materials entrusted to our care. It matters not whether we are manufacturing specifically for the military needs of the nation, or for private commercial ends, the question remains the same: What are we doing to conserve? It is plainly the duty of industrial managers everywhere, of the leaders of big business of every kind, and of the citizen in every calling of life, to study in this great crisis the conservation of waste and the salvaging of the by-products of production and every-day living as never before in the history of our country. Not a pound of metal or fabric; not a drop of essential oils or chemicals; not a piece of leather, rubber or wood; not even a scrap of paper, should be allowed to go to waste or escape the process of reclamation. All these things and numerous other by-products of manufacturing are urgently needed by our government in the prosecution of the war.

Conservation in manufacturing is akin to the conservation of natural resources but is more far-reaching, for it deals with materials of greater unit value and those upon which human labor has been expended. So the loss of industrial materials and wastes means a loss of human effort as well as the disappearance of natural resources. Furthermore, this loss extends to the labor and equipment needed for transportation and marketing and so reaches into every activity of industry.

Conservation in manufacturing is now recognized as one of the laws of production.

FAR-REACHING SIGNIFICANCE OF THE WORK

Salvaging industrial wastes has a more far-reaching significance than most people realize. The necessity for universal, energetic action is now multiplied a thousand fold. It is obvious the unnecessary consumption of finished fabrics or failure to reclaim by-products necessitates increased production of raw materials. In these raw materials are contained the essential elements required for all the various processes of war. Furthermore, increased production of whatever nature means additional labor, additional transportation facilities, the tying up of railway equipment, and congestion of traffic; all of which seriously affect the movement of the long list of military products required by our government.

It is manifestly of great importance, if we are to secure a practical working basis of economic manufacturing, to establish systems of control in every factory in the land. Systems must be set up which will not only insure the economic consumption of all materials employed in production, but which will also prevent every form of unnecessary industrial waste and accomplish the complete reclamation of all classes of by-products. Regular stock department reports are most essential for the purpose of showing the amount of various classes of material delivered to the manufacturing floors, but the establishment of systems of prevention and control, which preclude the possibility of waste, is of far more importance and of far greater effectiveness in securing the results we are seeking to obtain.

Unskilled Help A Source of Waste

With the exigencies of the war, most difficult employment problems have also arisen of a character which the manufacturer has never before had to face. Much of the new help which he employs has to be taught the simplest rudiments of shop practice. This condition materially affects precision in productive processes and is a fertile source of increase in industrial wastes. How to meet this condition is one of the serious problems of the day and one in vital need of being solved.

In the larger industries engaged in the manufacture of a diversified mechanical and electrical product, and in all industries the products of which are composed chiefly of metal parts, such as machinery for mills and factories, agricultural and traction machinery, automobile products, etc., metal scrap such as steel, iron, copper, brass, and various alloys, constitute the greater portion of the valuable by-products. The aggregate of by-products reclaimed annually in some of our chief industries amounts to many thousand tons. In one of the largest electrical industries, the General Electric Company's plant at Schenectady, it has amounted in the past two years to more than 40,000 tons per year.

Equipment for Reclaiming

In the bigger mechanical industries like the Schenectady plant it is essential to provide a building which can be devoted exclusively to reclaiming by-products. The building should be equipped with narrow and broad gage tracks and overhead traveling cranes for the receiving of incoming materials and also for loading for shipment. There should also be an equipment of metal separators, metal shears, presses, cutting and bundling machines, reduction furnaces, melting pots, and necessary benches, vises, saws, or other tools required in taking apart and preparing materials for shipment to the foundries and dealers. The contiguous outside area should be provided with ample trackage, loading platforms, storage sheds, and with gantry crane service for the handling of heavy materials and castings which must be stored while awaiting disposition. In small plants, a section of one of the shops or storehouses can usually be assigned to by-products. In these smaller factories the facilities and equipment required for reclaiming and handling scrap will necessarily depend upon the character or class of product manufactured and may be limited to comparatively few machines or tools.

Metal By-Products

For purposes of accounting it is always desirable to establish a system whereby the individual shop departments will receive credit for all scrap produced.

In the large boring mill and machine departments, steel boxes of approximately two tons capacity are placed in convenient localities near the machine tools, into which the chips and turnings can be shoveled with facility by the machine helpers or floor sweepers. These boxes are provided with hinged ends to facilitate discharging, and with handles for lifting with the shop cranes and conveying to the cars. This obviates the operation of wheeling out of chips to the sidings in barrows by the floor labor gangs, thereby effecting a good economy in cost of handling. This class of scrap is usually shipped in car lots in its original form, and weights are tallied on the railroad scales at the scale house.

The process of briquetting steel and iron borings and turnings, which has been established in several of the larger manufacturing centers of Europe in the cities of Berlin, Vienna, Buda Pesth, Stolberg, Chemnitz, Cassel, Milan, and in Switzerland at Winterthuer, has in recent years come into use to a limited extent in this country. It is one of the new developments for which, in connection with certain prospective metallurgical reactions, there appears a somewhat attractive field about to be opened up, and one in which the big industries of the country will more generally take interest in the future. In giving consideration, however, to the increased market value of steel and iron borings and turnings which have been briquetted, the cost of the installation and operation must not be lost sight of, which may and does have a very material bearing on the net gain to be credited to the operation. This is especially true where liberal market figures are already being obtained for these by-products shipped in their original form. In the present crowded condition of industrial plants it is obvious that the cost of installation in a very appreciable number of cases must include the erection of new buildings for the purpose, which will involve an important item of investment to be charged against the receipts. In general the larger industries throughout the country are still adhering to the practice of shipping their borings and turnings unbriquetted in car lots.

Handling Metal Chips and Turnings

In the manufacturing departments having machine tool sections devoted to the machining of small parts and in the automatic machine departments, the chips and turnings consisting of steel, iron, copper, brass, composition, babbitt, etc., are collected in steel barrows and containers, weighed, tagged, and sent to the general scrap building. The tag attached to the container designates the department from which the chips come, class of material, and weight. As far as practicable the scrap from these departments is kept separate in the processes of machining, the chips from one kind of metal being removed from the tool pans as soon as the job is finished and before another metal is started cutting. Chips removed from machines operating with cutting oils are run through oil separators before delivery to the scrap building. This process is a most essential one, the oil reclaimed amounting in some cases to a barrel, and in others to more than a barrel per ton of chips, according to operating conditions. This oil should be mixed with a proper proportion of new oil to bring its cutting value up to standard requirements.

Mixed chips and turnings from machines operated on short jobs, involving frequent changes of metal, and from those operated on parts assembled from two or more metals or materials, are collected by the floor sweepers and forwarded in barrels to the scrap building for sorting and loading.

Apparatus and materials designated by the mechanical inspection force of the shops to be scrapped have a blue tag attached at the time of inspection, and are sent to the by-products building where they are taken apart and all materials of value saved. Benches are provided for the men who do the work of disassembling, and the various metals and materials are sorted into barrels, boxes, or bins in preparation for shipment or consumption in the home foundries.

Saving Babbitt Scrap

Babbitt scrap is usually an important item in most mechanical industries. Frequently it is mixed with iron, brass, or composition, as is the case where it comes from machines employed on the process of turning and boring bearings, etc. When mixed with iron it is put through the magnetic metal separators and is then ready for reduction in the babbitt furnaces with the clean babbitt chips collected from the shops. The furnaces are located in an addition adjoining the main scrap building which is devoted exclusively to smelting and casting pigs. The capacity of the furnaces is 3,000 pounds per run, or approximately 12,000 pounds production per day. The pigs cast from these chips are worth the price of new babbitt metal in the open market. Babbitt dross contains a high percentage of pure metal when reclaimed, and is worth approximately 85 per cent. of market pigs. Lead dross yields about the same relative value in reclamation. During the year 1917 nearly 400,000 pounds of babbitt pigs were cast from scrap and used for home consumption, and more than 300,000 pounds of mixed babbitt and babbitt dross were saved and sold to the outside market. All lead dross is also saved and similarly disposed of.

Copper, Tin, Nickel, Aluminum, Etc.

The shop foremen should give special attention to saving all copper, brass, german silver, nickel, aluminum or other grades of metal in whatever form. This would include wire scrap, clippings, stampings, and cuttings from both metal sheets and solid stock left over from productive processes. Care should be exercised to prevent workmen from throwing small pieces of scrap metal into the shop waste cans, and the refuse from these cans should always be sorted and all metals picked out before sending the waste material to the factory dump or destructor plant.

Foundry slags and wastes from smelting furnaces in mills and reduction plants pay good returns on the labor expended in the process of reclaiming. The slag from the cupolas and furnaces should be carefully sorted and screened, in which case there will be little material of value left. The percentage remaining will not usually be sufficient to require the operation of a cinder mill. In the brass foundry there is always an accumulation of metal waste which yields a good return. This residue requires more care and equipment in the process of reclaiming. In general the coarser portion is put through a crusher to render it in shape for screening or separating by electric-magnetic process. With suitable jigs, screens, tables and magnetic separators, all of the finer particles of metal can be saved.

It is good practice to gather all the refuse from the foundry floor, which may contain particles of metal, and by means of one or more of the several reclaiming processes, reduce the metallic portion to a condition and shape suitable for use in charging. The by-products from reduction and smelting processes in laboratory furnaces and retorts, and by-products from laboratory production in general offer a wide field for valuable conservation work. Many valuable metallic elements in the form of wastes and residues, such as aluminum, molybdenum, tungsten, barium, etc., can be reclaimed and used again in production with a comparatively greater profit than in many other classes of manufacture.

Building Construction—Improvement and General Repairs

Waste materials left over from building construction and repair work comprise a large list. Alterations and repairs to buildings often involve the removal of steel angles and beams, sheet metal, piping and wiring, cables, etc. All of this product of factory additions and alterations is of the highest value. Much of it can be saved and applied on other jobs. The same is true of materials used on extensions and repairs to plant trackage and on repairs to machinery and shop tools, and improvements and repairs in general. It is good practice to establish a system of clearing up leftover materials immediately on completion of work, and making disposition either by returning to stock or sending to scrap. Regular inspections of manufacturing departments and of contiguous areas between shops and buildings, as well as storage sheds and platforms, should also be made with a view of collecting and disposing of metals and fabrics left over from productive processes, and of obsolete and waste products of every kind.

In making inspections and repairs on shop tools and equipment, special attention should be given to conserving tools which may be put in condition with a reasonable expenditure of labor and material for repairs. In some shops there is a tendency to discard broken tools and purchase new equipment, often at large additional cost, rather than make the necessary repairs.

Collecting and Saving Shop Tools

It is also essential to establish a system of collection of lathe and planer tools which will insure that these are gathered regularly from the machine shop floors as they become worn, and sent to the forge shop for repointing and grinding, after which they may again be given out from the tool stock room to the workmen. It is a common practice in some shops to leave partly used cutting tools lying about machines and cupboards until large accumulations result. Most of these tools can be repointed several times, or reshaped for other processes to good advantage before they are completely used up, and the remnants melted over into new stock. Each tool should receive inspection and be put to fullest service for which it was designed before being replaced.

Tool steels in various shapes and sizes are often left lying about the machine sections and tool-making departments without any good reason except lack of attention to system on the part of the supervisor in charge. All these remnants and left-over pieces are of the utmost value in new tool production and repairs.

Bolts, nuts, washers, pins, etc., left over from productive jobs should be returned promptly to stock by the workman. Unless this practice is followed, these articles are apt to lie around the benches and floors indefinitely and finally reach the scrap department with other materials as waste products. It is the practice of the supervisor in charge of the main by-products building and of the collection and disposal of scrap in the Schenectady plant to systematically save all materials which may be of further use in the manufacturing departments or in the work of maintenance and repairs. Particular attention is paid to the sorting and preparation of all the various classes of metals in order to meet the market rulings as to condition, size, and form in which the different grades must be shipped, and also to obtain the highest quotations which the market affords.

Vestibule School of Lincoln Motor Co.

A Gateway for Women to Enter Effective Production in Industry

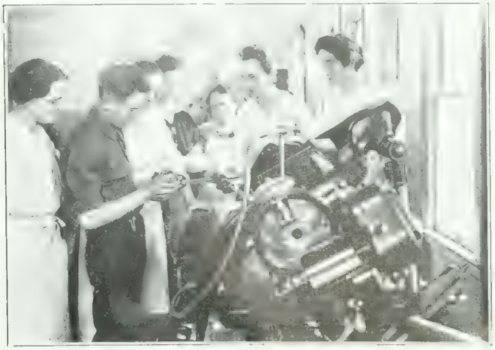
By J. M. Eaton

In June, 1917, the Lincoln Motor Company was founded by the veteran automobile builder, Mr. Henry M. Leland. In a little more than a year this company has gathered together a management and a working force of 6,000 persons to produce Liberty motors. Many women have passed through this school and are now engaged upon the following operations: Drilling, milling, turning, slotting, grinding, gear cutting, broaching and in operating screw machines and automatic lathes.

Mr. J. M. Eaton *began his training in industry as a chainman and later as assistant to a surveying corps. Afterward he managed a successful business of his own. His experience in employment matters began with the Westinghouse Electric & Manufacturing Company, where he spent six years in that firm's employment department. His next position was that of employment manager of the Oliver Chilled Plow Works. He was for three years with this firm and installed their employment system and handled all industrial relations. Later he was for six years welfare manager of the Cadillac Motor Company, and since June, 1917, has been industrial manager of the Lincoln Motor Company in Detroit, Michigan.*

IT is a rare thing nowadays to meet a man seeking employment who has served his apprenticeship at the machinist's trade. The toolmaker who signed articles and put in his first year at five, eight or twelve cents an hour, and the succeeding three years at a figure only a little more advanced in order that he might, at the end of his long period of training, have a legal and moral right to call himself a journeyman, is not to be found in the queues stretching back from the employment office door. He is much more likely to be found within the shop directing the energies of those less skilled than himself and endeavoring, even with the handicap of indifferent and untrained help, to get out the production so badly needed.

It has often been said that this is an age of specialization and this is particularly true of our industrial life. Advanced methods of manufacturing have contributed in a large degree to the elimination of the all-round man, and the era of prosperity through which we have been passing has done the rest. In our great manufacturing plants men daily do their task, knowing little—many times nothing—as to the function of the single part that passes through their hands. They have acquired their mechanical education in what to them appeared to be a free school, but which was in reality one supported by an employer who, in his desperate need for help, was willing to take at face value the statements made by the pupil as to his qualifications, and who contributed in time, money and waste material toward putting his pupil through one more grade of his course.



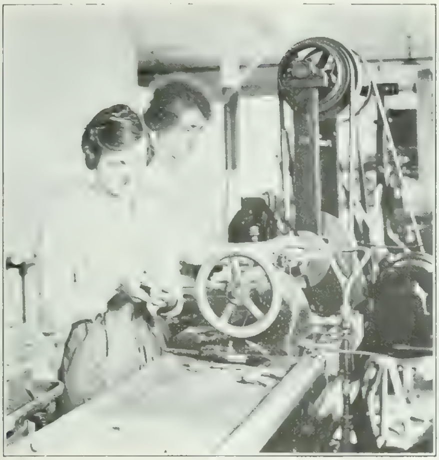
VESTIBULE SCHOOL—INSTRUCTION IN GEAR CUTTING

GREATER PRODUCTION WITH NEW MEANS

The never ending migration of help, with its consequent increase in rates and the ease with which positions may be secured, has made men indifferent as to the final polish of their mechanical education. Prior to the present war, increased production was a matter of more buildings, more machinery and more men, rather than a greater effort and more efficient service upon the part of the individual. With the taking from industry of millions of men, a slow but certain and sure reaction is inevitable and the industrial slacker is rapidly coming to be as much a subject of contempt as is his brother, the military slacker. The need for immediate greater production forces upon the mind of employer and employee alike the necessity for greater individual effort. The patriotic desire to do all things possible, and all things well, has in turn created a desire for more complete knowledge and greater personal efficiency.

The introduction of women into branches of industry hitherto strange to them, and their unselfish and patriotic desire to equal, if not excell, in productive efficiency the men whose places they are temporarily filling, to-

VESTIBULE SCHOOL—SCREW MACHINE INSTRUCTION



MACHINE INSTRUCTION IN VESTIBULE SCHOOL

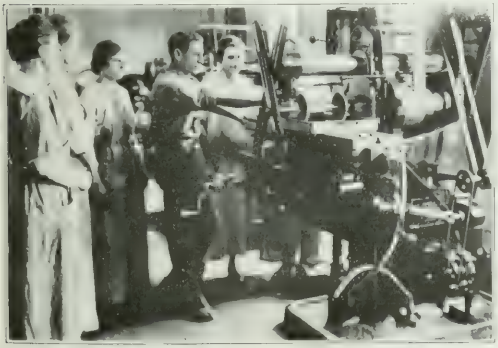
USING A MICROMETER ON MAIN BEARING BOLTS

gether with their natural inclination to become pace makers is contributing much to the change which we view. The eyes of the world, and particularly the industrial world, turn to its women—the same gentle force that in peace times encourages men to greater accomplishment—confident that in a world crisis they will unhesitatingly arise to the occasion, and provide with the delicate skill of their fingers those implements of warfare for which cries out the manhood of the nation. Therefore the more general appearance of women gives special interest to methods of the introduction into and the training of them upon mechanical operations, and it seems to be generally conceded that the so-called vestibule school has advantages not possesssed by any other plan. Particularly in munition plants and especially in those which have been engaged in the manufacture of small parts where close limits prevail has this plant lent itself most readily to the purpose of quickly making available a large force of efficient and loyal operators.

Founding the Lincoln Motor Company

The Lincoln Motor Company of Detroit was conceived in the brain of Mr. Henry M. Leland during the month of June, 1917, and came into being during July of that year. Starting without a plant or a machine the company, under the generalship of its patriarchal founder has, within a year, taken over, remodeled and equipped a group of buildings formerly used for the manufacture of automobile parts, and in addition has erected, equipped and manned a new plant which not alone gives employment to 6,000 persons in the production of the now famous Liberty Motor for aeroplanes, but which is said by engineers and manufacturers of experience to be one of the finest groups of buildings and best machine-tool layout in this or any other country.

With the building up of this immense organization in so short a time came the problem of how to secure a sufficient supply of capable operatives. Along with the building and tooling of the plant came the national military draft, calling from industry thousands of the young men upon whom dependence would ordinarily have been placed, and other thousands were absorbed by the great



VESTIBULE SCHOOL—INSTRUCTOR GIVING FIRST LESSON ON CAM MILLER

HAND MILLING MACHINE OPERATORS

shipbuilding and munition plants which seemed to spring, full grown, from the earth overnight. Specialized operatives in large numbers were not to be had, and men of the lesser grades of skill seemed unwilling to lend themselves to any scheme of training which would fit them for the work, much preferring to accept menial places at rates which keen competition had raised to an almost unbelievable height.

A GENERAL VIEW IN THE VESTIBULE SCHOOL, LINCOLN MOTOR CO.

RECRUITING WOMEN

In this emergency it was thought proper to turn to the woman power of the country for that help which meant the winning or loss of the war. Somewhat uncertain as to the number or class of women who would respond to such a call, an advertisement was inserted in two city newspapers setting forth that intelligent, loyal American-born women not under 21 years of age, and preferably those having husband or brothers at the front, might be used upon mechanical operations where they would both be of service to their country and to themselves. It was stated that prior experience was not essential but that a high moral character was a prime requisite. This advertisement appeared two days only. It was blind in its make-up, so that the reader did not know the identity of the advertiser, and brought to the desk of the industrial manager something over 1,700 replies. This was followed by bringing in for interview those applicants whose letters indicated more than ordinary intelligence and they were talked to by a woman employment supervisor keen in her desire to secure women of high moral character, willing to go into the shop under instruction for whatever sort of work it was finally decided they were best suited to do.

EQUIPMENT OF THE TRAINING ROOMS

A small room about 18 by 30 feet was set aside as a training room and into this was put a Whitney hand milling machine, two Cincinnati No. 2 milling machines, one 14-inch lathe, one No. 2 Warner and Swasey screw machine, one 6-inch Gleason gear generator, one Leland-Gifford speed drill, one Porter-Cable lathe, a small grinding head and such benches, etc., as the space permitted.

In charge of the room was placed a young man of engaging personality, high grade mechanical ability and unusual enthusiasm and patience. The women were told at the time of employment something of the ideas and ideals of the management; what it was hoped we might accomplish; the importance of regularity of attendance and our resolution that nothing but honest material and equally honest workmanship should enter into our product. They were formally introduced to the instructor, who talked with them regarding certain fundamentals of shop practice and our ideals as to quality of product. They were then grouped and following the plan generally prevailing in schools of this type, were lectured upon the construction, purpose and use of the machine tools, the instructor demonstrating upon the machine in question the points he desired to make.

Following this the women were permitted in turn to operate the tool, under careful instruction, upon production work and as instruction progressed and certain ones developed special proficiency they were moved to another group under instruction at another machine. After instruction had been given and their adaptability observed, they were given additional and special instruction upon that machine for which they seemed to have a special liking or showed special skill. This procedure was varied at times depending upon the urgency of supplying the needs of the shop and at times it was found necessary to give instruction upon but one machine, and in the early history of the school that training was sometimes necessarily very limited. The period of instruction lasted usually from three to four days, following which the woman went into the shop confident and capable upon the particular machine to which she was assigned. Here her training was continued, under the eye of an instructor unhampered by other duties, until she was able to approximate maximum proficiency, which was accomplished in a short time.

WOMEN TESTING INTAKE HEADERS

DOUBLE BENCH WHERE VALVES AND PISTONS ARE TESTED

700 Women Have Been Trained

Practically all of the 700 women, except those engaged upon certain inspection work, have thus been taken into the organization and trained. Practically none of them had previous machine-shop experience and a large percentage were those who were taking the place of bread winners in the family who had gone into military service. School teachers, department store clerks, telephone operators, candy makers, book agents, domestic servants and women who had previously been engaged in light employment or as housewives made up the force. But few failures or disappointments have been recorded, although occasionally it became necessary to return a woman to the school for additional instruction along a somewhat different line than that for which she was first intended. This was to be expected, and except in one or two cases it has not been found necessary to dismiss a woman because it was not in her to adapt herself to shop conditions or shop work.

TURNING MAIN BEARING BOLTS—GIRL TRAINED IN SCHOOL

The school, in addition to having trained a force of mechanics—for no group of apprentice trained mechanics could be more conscientious or jealous as to the quality of their product—has enabled us to introduce into the productive organization women divorced from the fear of the shop and willing and anxious to render a service, not for the remuneration alone, but for the sake of the service itself.

Their *esprit de corps,* the loyalty to company and those superiors under whose direction they work, their keen patriotism and the jealousy for the maintenance of a group which shall be known for its efficiency and its high type of American womanhood, is something for which the school is in a large measure deserving of credit. This brings to those who have had a part in the building up of such an organization a sense of gratification and pride, yet withal a realization that the success of the school is due in large proportion to the whole-hearted coöperation of those who have passed through its courses and taken their places as good mechanics.

* * * *

Importance of Employment Management

Of primary importance in developing an interested, contented and coherent working force in industry, is the careful selection and placement of those seeking to enter it. But the demands made upon industry within the past century and a half, in organizing its buying, manufacturing, selling and financial departments to meet the rapidly extending market, have obscured the problems of employment. Before the war, when a textile manufacturer in Massachusetts was perhaps buying his wool in Leicestershire, his dyes in Germany and his machinery in Pennsylvania, he was probably waiting to "buy" the first chance applicant at the factory door to fill the vacancy in his working force. Moreover, he had small regard for placing the applicant where both the worker and the industry would profit most from his labor; nor did he make real effort to retain his services, once secured, beyond offering him the regular, impersonal wage payment of the purchasing price of his class of labor. Such is the average employer's careless attitude toward his "human machinery." But now that the other four branches of industry have become differentiated and functionalized, a fifth branch, that dealing with the human factor, is pressing for similar treatment.

Current labor turnover figures, both before and since the beginning of the war, have revealed in part the absurdity of the assumption that any particular industry, without conscious effort, attracts and holds in its employ those workers best fitted for it. The physical, mental and temperamental fitness of each employee for the work which he is to do, contributes to the development of a contented, effective working force, with a tendency toward stability. Such a condition of mutual satisfaction is obviously not prevalent in industry today, and it is one of the basic difficulties, that of obtaining and retaining the worker best fitted for the work to be done, which constitutes the employment problem.

There are four phases in employment, namely: securing, selecting, inducting and retaining efficient workers. First, choice predicates quantity from which to choose and few employers ran rely solely on the "peddlers" of labor who come to their doors to provide them with the necessary quantity and quality of applicants for employment.—From *Hiring and Firing,* published by the Metropolitan Life Insurance Co.

Cost Accounting to Aid Production—III

The Universal Law of System

By G. Charter Harrison

In this third installment of Mr. Harrison's *series he states emphatically that there must be a cost accounting system if the cost accounting of a business is to be properly done; that the procedure must be carefully planned to attain the desired ends; and that this planning must be done by some one who knows how. By way of illustration a diagram is given showing the basic features of a simple cost system for a business manufacturing various kinds of machines of a standard character. The method is also given for figuring standard costs.*

Mr. G. Charter Harrison *was born and educated in England and passed eighth in order of merit in the final examination of the Institute of Chartered Accountants in England and Wales. For eight years, up to October, 1908, he was employed by Price, Waterhouse & Company in various capacities; during the latter part of this period as manager of the system division of that firm. From January, 1909, to February, 1911, he was comptroller for the Russell, Burdsall & Ward Bolt & Nut Company. At the latter date he returned to Price, Waterhouse & Company to take up the managership of the system division. In November, 1916, he entered into a partnership with the principals of Baker, Sutton & Company, London, England, chartered accountants under the firm name of Baker, Sutton & Harrison. This firm practiced in New York City as industrial engineers and chartered accountants. Owing to conditions brought about by the war that firm was dissolved in May, 1918. Mr. Harrison took over the business and continued it under his own name.*

ALL of a man's most cherished possessions will not be found on the schedules of an appraisal of his property, and the assets of a business most difficult to acquire or to replace do not all appear on its balance sheet. In the final analysis the prosperity and even the continued existence of a business depend as much upon its intangible assets—upon its good will, its policies and the spirit of its organization as upon its buildings, machinery and other material evidences of its prosperity.

In order to be able to render the policies of a business effective, to multiply its own usefulness and to add to the tangible assets and good will of the business, in addition to the physical equipment requisite for production, distribution and administration the organization requires some kind of an established routine for performing the various operations necessary for the conduct of the business. Such a series of standard routine methods may properly be termed the "system" of a business.

Unfortunately, the word "system" is associated in the minds of many with the memory of unsatisfactory experiments conducted in its name by those who have confused external details with fundamental principles and because, for instance, in applying the principles of system it has been found convenient and expedient to use standard printed forms have endeavored to obtain results merely by introducing a multiplicity of printed forms without possessing a knowledge of underlying principles. Printed forms and mechanical devices such as adding machines, duplicating, calculating, sorting, billing, tabulating and time-recording machines have their place and are of great value, but an office may be equipped with all of these and yet if the methods employed are not founded upon correct principles satisfactory results will not be obtained.

There is no other word, however, which satisfactorily conveys the same ideas as that expressed by "system." In view, therefore, of the paucity of our language rendering it necessary for us to continue to retain this word in our daily vocabulary probably the best course to follow is to clear its character of the false impressions which have become associated with it by determining its true meaning. "System" in a standard dictionary is defined as being:

> A whole plan or scheme, consisting of many parts connected in such a manner as to create a chain of mutual dependencies.

Obviously under this definition we live in a world of systems and of systems within systems, the universe as a whole being one immense system embracing incalculable billions and billions of minor systems from that of the system of which our sun is the centre down to the respiratory system of a gnat dancing in that sun's declining rays.

In dealing with system therefore we are discussing no mean thing and in endeavoring to apply its basic principles in the operation of our business we are really engaged in an effort to bring the same into tune with the fundamental laws of nature.

UNITY UNDERLYING SYSTEMS

As an indication of the unity which we might expect to find underlying all systems, whether of philosophy, of business, or of the universe, it is interesting to note the close parallelism existing between the system of the human body and that of an established business. The development of the former has been the result of untold ages of experiment, of trial and error, and of the operation of the inexorable law of the survival of the fittest and yet in many respects man has instinctively adopted the methods of the body in the solution of the complex business problems which have been the growth of the last few hundred years and mainly of the last few decades.

One of the most difficult and complex problems which required solution in the evolution of the human body was the finding of some means whereby a multitude of routine duties could be carried along without conflicting with the performance of operations calling for the exercise of the higher faculties. This problem was solved by the development of the nervous system, as to which Professor David Fraser Harris in his book entitled "Nerves" writes:

> Now it is very natural at this point to ask what exactly is the nervous system for. . . . It is first of all for carrying out certain activities, such as breathing, on a subconscious plane, *over which the constant supervision of consciousness would be tedious if it were not impossible considering the enormous number of demands made upon the attention of the individual. It is in the next place for carrying out certain activities with the greatest possible speed compatible with the greatest possible accuracy.*

Now, in the operation of a business we are confronted with a similar problem to that solved for the body by the development of the nervous system—namely, to find some means whereby an immense number of routine operations can be performed quickly, accurately, economically, and with a minimum of supervision on the part of the business executive. The solution of the problem in both cases has been practically identical, in the body the conscious mind has been relieved of an overwhelming burden by handing over routine duties to the nervous system, while, in the case of business, standard methods of performing routine duties have been devised and installed, in which methods the organization is so drilled that its performance of these is more or less automatic.

As regards the tremendous advantages realized by the body from its nervous system, Professor Harris states:

> Nerves and the nervous system not only protect the individual from injury enabling him to seek food, avoid or overcome enemies; *but they are constantly handing over some activity or other from the conscious to the subconscious realm.* . . . . . . We educate the nervous system laboriously to perform certain actions, conscious attention being very much concerned in the acquisitions, but by degrees these acquisitions are relegated to the unconscious or at least subconscious realm and are at last carried on without the interposition of attention at all. *There is a very great saving of nerve energy here; things so done are called habits.*

The first steps taken by a child call for the concentrated use of the conscious mind but after the method of walking has been firmly established the nervous system takes over this function and most of the time that the adult is walking he is hardly even conscious of the fact. The first time we ride on a bicycle there is a desperate trial of our conscious faculties, but after the habit has been acquired the business becomes entirely mechanical, so much so in fact that in long distance bicycle races the rider has been known to ride while asleep. More than once was it noticed by the men in the boat that the cross-channel swimmer Holbein was asleep though still swimming, and we are all familiar with the absent-minded way in which when interested in a conversation at the table we help ourselves to the sugar without losing for one moment the thread of the conversation.

An important feature in connection with the more or less automatic functioning of the nervous system in carrying out routine operations is the fact that though this system is at all times ready to relieve the conscious mind of the necessity of performing routine operations, in so doing it will not vary one iota from the manner in which the performance was laid down by the conscious mind and it is to this peculiarity that we rightly attribute the importance of acquiring good habits.

However, as Ralph Waldo Emerson in his essay on "Compensation" stated: "Everything has two sides: Every advantage has its tax," and the individual who takes advantage of the benefits resulting from being able to relieve the conscious mind of the necessity of supervising the performance of routine duties cannot avoid the acceptance of the corresponding responsibility and of the danger of permitting the facility of the nervous system in this connection to result in the formation of bad habits.

Occasionally parents who desire their children to become skilled in the art of playing some musical instrument make the mistake at the outset of employing semi-skilled instructors to undertake the initial training of the child, to find in after years when they call upon a master in the art to "finish" the pupil's education, that the work already done has been worse than useless, more effort being required to break the old, bad habits than to acquire the new, right ones.

Bad Business Habits

Bad habits are as detrimental to a business as to an individual. Incorrect methods of performing routine work once firmly established cannot be corrected without a struggle. The path recommended may be far shorter than the one now followed, but to take it involves the trouble of blazing a new trail and of getting out of the old rut whereas to continue along the well-worn and familiar path is to follow the line of least resistance.

Unfortunately, in many cases it is not possible to adopt the ideal plan of carefully formulating our methods before we embark on our business venture and by this means acquiring good routine habits at the outset, though this plan has been followed successfully by some foresighted executives launching new undertakings on a fairly large scale. In the great majority of cases, however, the problem presented involves not only the determination of what the correct methods should be, but also the necessity of breaking away from established, defective routine before the improved methods can be introduced.

According to the definition previously given the idea of system is that of a number of interrelated and interdependent parts so connected as to form a complex whole and the attainment of perfection in this whole not only demands perfection in the individual parts, but also requires the attainment of the same standard in the adjustment or balancing of the parts with one another. Broadly speaking, no business problems are strictly intradepartmental, what affects one department in some degree affects all the others. In the average business, however, this fact is in large measure overlooked and, due partly to the fact that each department is generally left to work out its own salvation unaided and partly owing to jealously of any encroachment upon their particular domain, the department heads devise ways and means of meeting their own particular needs without much reference to how these methods conform to the requirements of related departments. Under these conditions such coördination as is realized is more the result of dire necessity than of a carefully thought out plan under which the interest of the business is paramount and that of the department or individual subordinate thereto.

Why Business Methods Fall Short

It is rarely in a large business that any person can be found who is able to completely recite the routine followed in the handling of an order from its receipt in the mail throughout all the intermediate operations up to the final shipping and billing of the material nor is it often found that any attempt has been made to analyze such routine with a view to eliminating duplication of work and overlapping of authority. Under such conditions it is hardly to be wondered that the methods employed fall far short of the ideal.

As an illustration of the ramifications involved in the modern manufacturing institution there is shown in Figure 4 a representation of the operations involved in the handling of an order in a concern where the requirements though complex are not by

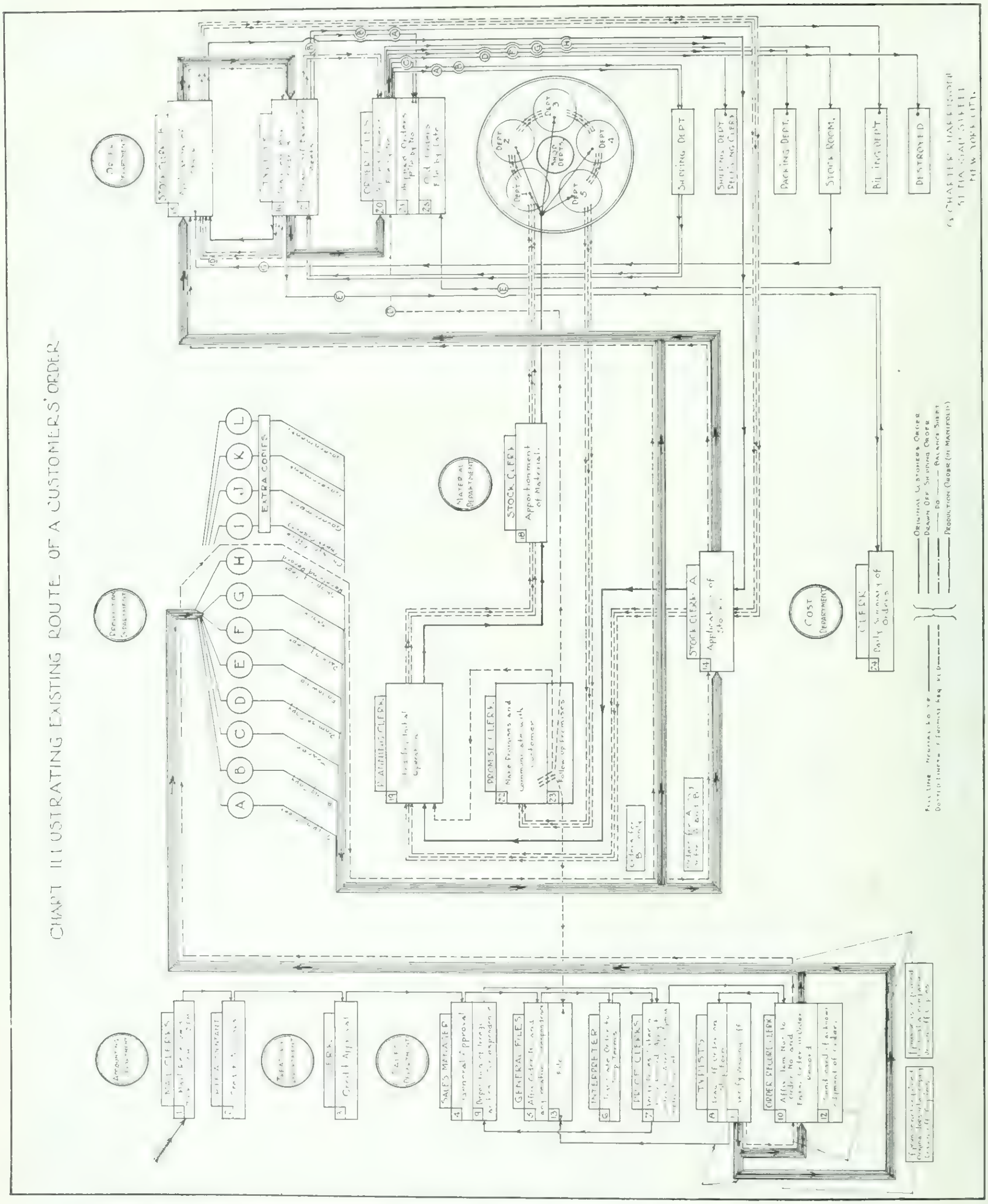


FIG. 4. DIAGRAM ILLUSTRATING COMPLEX CHARACTER OF ROUTINE OPERATIONS NECESSARY IN A MODERN FACTORY

any means exceptional. A consideration of this diagram which covers only a small section of the routine work of a large organization will indicate how extremely difficult it would be for the average mind to visualize clearly the innumerable relations and operations involved in the conduct of modern business without the assistance of drawings illustrating these in complete detail. Unless the practice of machine design is followed and all the parts of the plan or scheme and their various interrelationships are clearly shown on paper it is practically impossible to determine where the routine employed involves duplication of authority and effort and working at cross-purposes, where methods of check are defective or overlap and where essential requirements are overlooked and non-essentials introduced. Due to the absence of such diagrams, the conception in the mind of the average shop or office employee of the methods employed in the operation of a business outside of his own immediate duties is little more than a blur and this applies to the ordinary routine work of an office, to the methods of accounting employed and to the system of controlling the progress of work throughout the shops. It would be difficult to overestimate the educational value of a series of diagrams illustrating all of the routine of the business rendering it possible for every member of the organization to obtain an intelligent conception of the business as a whole and of the relationship of his particular work to the general plan.

Procedure in Planning Routine Work

In laying out any plan of routine work the logical procedure to be followed is firstly to define clearly the ends which it is desired to attain and then to determine the simplest and most effective means of realizing these. This statement would seem so obvious that it may be thought that this plan would be followed in a general way by every man of intelligence, but the writer has come across cases where years have been spent in an endeavor to introduce satisfactory cost-finding methods by men who at no time have possessed anything more than the vaguest idea of what they were endeavoring to achieve. To minds like these the reverse of the logical procedure is followed; instead of laying down a general plan and then formulating the details to fit, they start out with small refinements here and there trusting ultimately, doubtless, to be able to coördinate these disconnected ideas in one grand plan. It is not by any means unusual to find cost accountants who have endeavored to develop such refinements of burden distribution that an attempt is made to apportion the cost of heat and light to departments and subdepartments, but who have overlooked such essentials as the control of raw material. The writer knows of one case where a store accounting system was introduced under which it was necessary for one clerk to devote his entire time to keeping track of the cost of bolts, nuts and screws which involved an expenditure of considerably less than his salary, and yet under this plan several hundred thousand dollars of other material was shown on the books as being on hand when as a matter of fact it had been used in the manufacture of product shipped and billed months before.

There will continue to be wasted efforts in connection with cost accounting, such as have been described, until manufacturers generally obtain a better conception of the results they can legitimately demand of their cost accountants. The average manufacturer does not really know what information he should expect his accountant to furnish him, and as a rule his demands fall far short of what should be considered reasonable. Even such limited information as he calls for, however, cannot be furnished under the more generally accepted cost accounting methods, the limitations of which will be fully appreciated if the results obtained therefrom are considered in the light of the list of reasonable requirements of a cost system given in the first installment of these articles.

Special Qualifications Needed to Design a Cost Accounting System

As soon, however, as the manufacturing world breaks away from the older idea of retrospective cost accounting and accepts the newer and broader conception of predetermined costs there will come a fuller appreciation of the dignity and importance of cost accounting. Instead of as at present expecting a more or less inexperienced cost clerk to work out his own salvation in the design of cost finding methods or calling for the assistance of professional accountants whose experience in the main has been confined to auditing and financial investigation work, the manufacturer of the future will undoubtedly employ the services of consulting cost experts not only experienced in the principles of accounting, but skilled in their application to meet the needs of the manufacturer. Sooner or later it will be realized generally that the designing end of cost accounting work calls for special qualifications not necessary for the operation of a cost system, and that only in very large institutions does it pay to retain as cost accountant a man with the extensive training and special ability necessary to design systems to meet the needs of the complex modern business machine.

The work of designing systems of cost accounting to meet modern industrial conditions demands a thorough training in the application of accounting principles which public accountants are better able to obtain than accountants outside the profession, and this field of cost accounting would seem to offer attractive possibilities to this profession. Until professional accountants, however, realize that an extended experience in auditing and investigation work in itself is not sufficient to qualify a man to solve cost accounting and allied industrial problems, their efforts in this direction will continue to be unsatisfactory and to result in such expressions of disapproval as the one quoted in the first of these articles:

> The employment of an expert accountant to devise and install a cost system in a manufacturing and repairing shop is an absurdity.

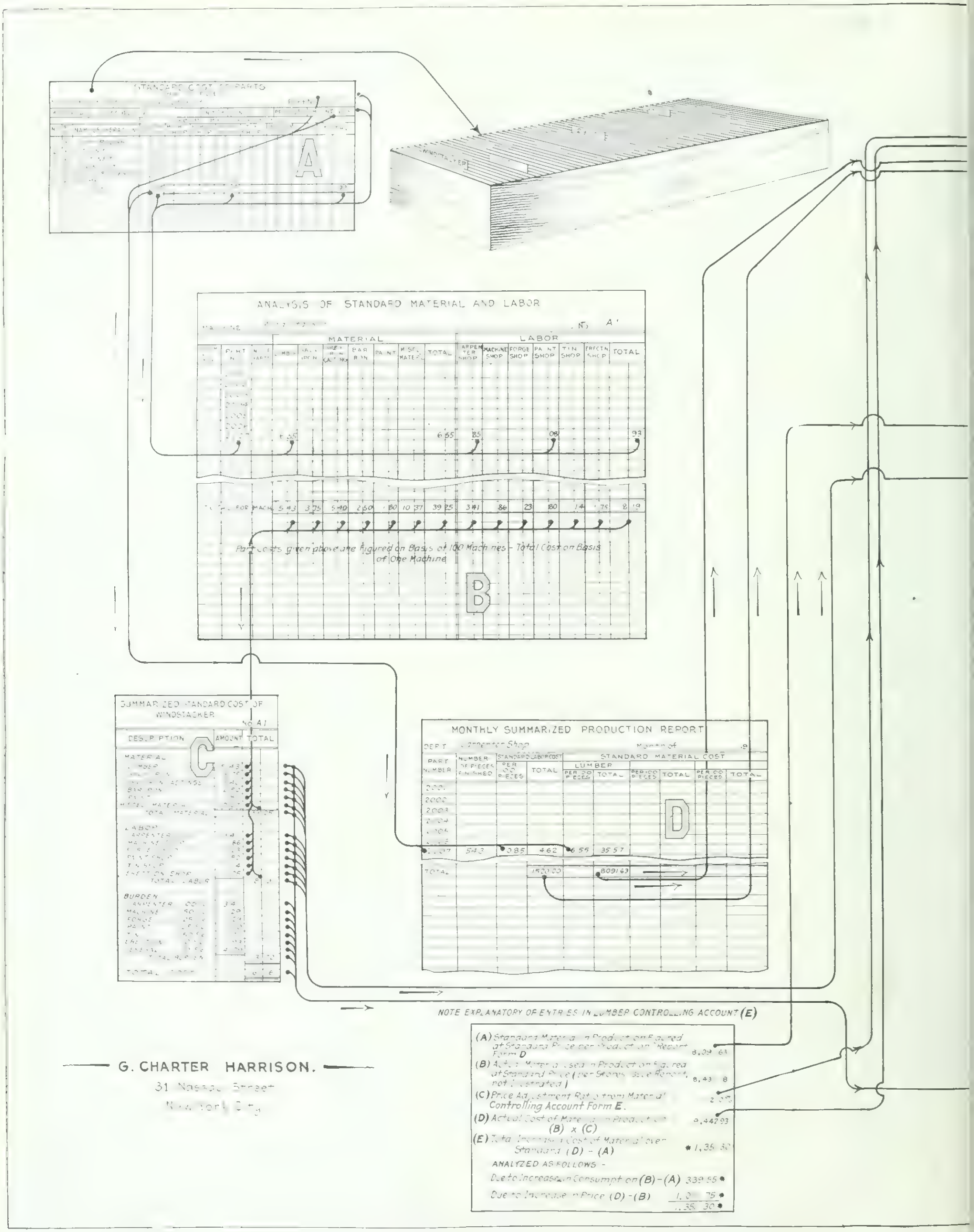
Basic Features of a Simple Cost System

In last month's installment of these articles there was illustrated (Figure 3, pages 394 and 395 of the November number) a plan of standard or predetermined cost accounting to meet an exceedingly simple and in fact practically impossible situation in which the business of a manufacturer was confined to the making of a single size of machine bolt. The plan there submitted illustrated the general principles underlying the author's methods of using predetermined costs in connection with obtaining information as to manufacturing efficiencies, current costs and costs of sales.

In Figure 5 herewith is given a diagram illustrating the basic features of a simple cost system to meet more complex conditions, the business taken as an example being one in which various kinds of machines of a standard character are manufactured involving the making and assembling of a large number of parts and the performance of several times as many operations. This plan has been drawn up to demonstrate that it is possible to design a system of standard or predetermined costs which will meet all essential requirements, giving results not possible under the expensive and detailed retrospective cost systems and yet involving a minimum of clerical work both in the shops and the offices.

A plan such as is illustrated in Figure 5 is especially sutiable for a concern where it is desired to obtain the essential cost information necessary for the proper operation of the business with the least possible disturbance and expense, leaving the development of the system as regards the production of refinements of information until some later time when the organization has been gradually educated to the point of demanding and being able to use such refinements of data as will be illustrated in later installments of these articles.

An essential requirement of the retrospective cost



(A) Standard Material in Production Figured at Standard Price per Production Report Form D 8,09 63

(B) Actual Material used in Production figured at Standard Price (per Stores Issue Report, not illustrated) 8,43 8

(C) Price Adjustment Ratio from Material Controlling Account Form E. 2 [illegible]

(D) Actual Cost of Material in Production (B) x (C) 9,447 93

(E) Total Increase in Cost of Material over Standard (D) - (A) * 1,35 30

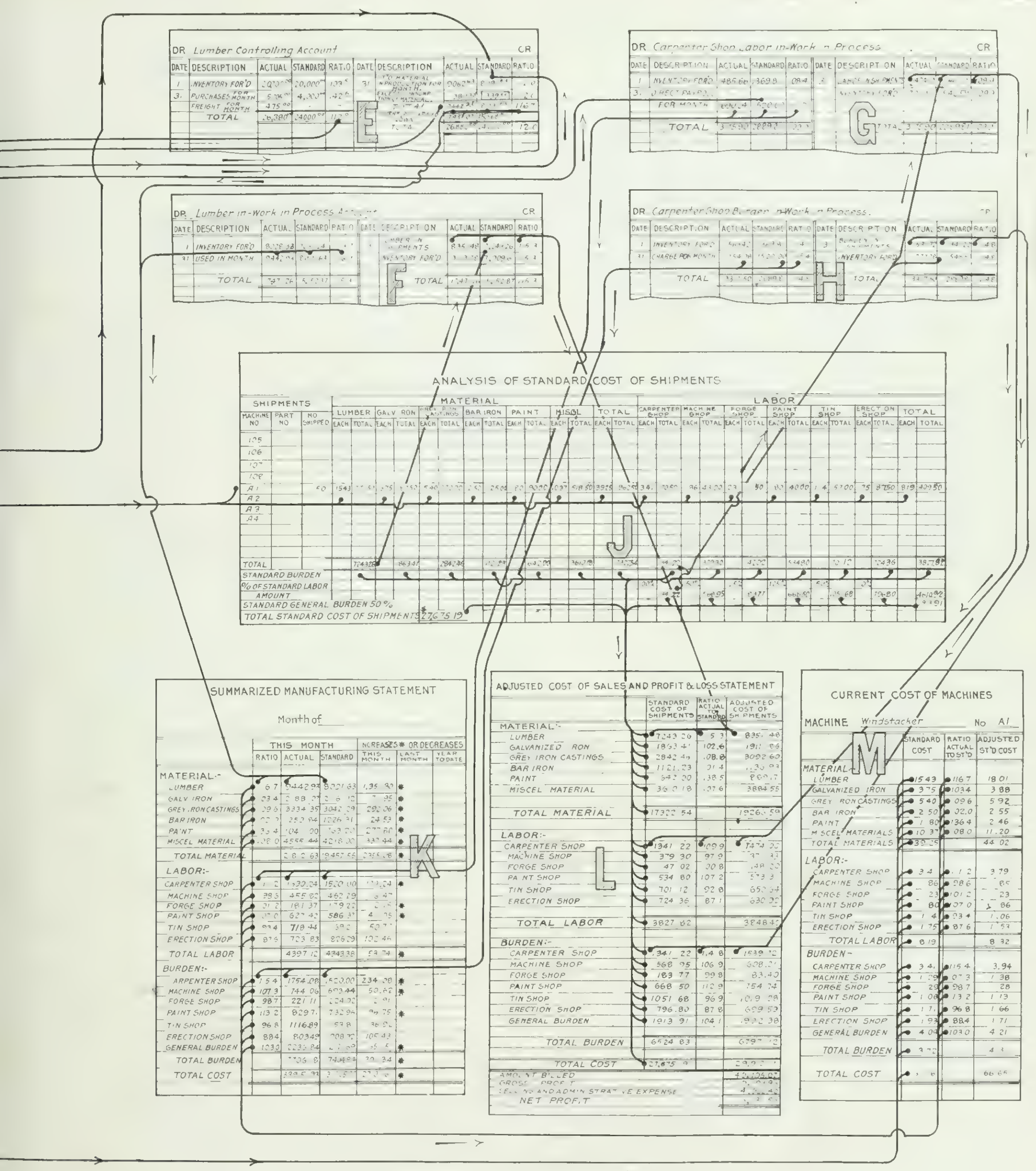
ANALYZED AS FOLLOWS -

Due to Increase in Consumption (B) - (A) 339 55 *

Due to Increase in Price (D) - (B) 1,0 75 *

1,35 30 *

FIG. 5. DIAGRAM ILLUSTRATING ESSENTIAL FEATURES OF A SIMPLE SYSTEM OF


DR Lumber Controlling Account CR
E
DR Carpenter Shop Labor in-Work in Process CR
G
DR Lumber in-Work in Process Account CR
F
DR Carpenter Shop Burden in-Work in Process CR
H
ANALYSIS OF STANDARD COST OF SHIPMENTS
SHIPMENTS
MATERIAL
LUMBER
GALV IRON
GREY IRON CASTINGS
BAR IRON
PAINT
MISCL
TOTAL
LABOR
CARPENTER SHOP
MACHINE SHOP
FORGE SHOP
PAINT SHOP
TIN SHOP
ERECTION SHOP
TOTAL
STANDARD BURDEN
% OF STANDARD LABOR
AMOUNT
STANDARD GENERAL BURDEN 50%
TOTAL STANDARD COST OF SHIPMENTS
J
SUMMARIZED MANUFACTURING STATEMENT
Month of
THIS MONTH
INCREASES * OR DECREASES
K
ADJUSTED COST OF SALES AND PROFIT & LOSS STATEMENT
STANDARD COST OF SHIPMENTS
RATIO ACTUAL TO STANDARD
ADJUSTED COST OF SHIPMENTS
AMOUNT BILLED
GROSS PROFIT
SELLING AND ADMINISTRATIVE EXPENSE
NET PROFIT
L
CURRENT COST OF MACHINES
MACHINE Windstacker No A1
STANDARD COST
RATIO ACTUAL TO ST'D
ADJUSTED ST'D COST
M

NOTE

* INDICATES RED FIGURES TO REPRESENT INCREASED COST.

PREDETERMINED COSTS FOR A MANUFACTURER OF A VARIED LINE OF MACHINES systems in vogue is the obtaining of complete detailed distributions of the time of productive workers. If a day work operator is working on 15 or 20 different jobs during the day in order to be able to operate the cost system, it is necessary to figure the elapsed time for every one of these operations. In some factories there is a serious loss of time owing to the necessity for men leaving their machines and taking a card to be stamped upon the completion of every job.

Under the author's methods of cost accounting the information that is considered of prime importance is that John Brown's pay this month was $76, whereas the standard value of the work he did was only $59. The question of the amount of time he spends on individual jobs is considered of relatively minor importance, the outstanding and dominant fact being that John Brown as a whole is not a profitable investment. Once predetermined costs have been figured for each operation, to ascertain the relation between John Brown's pay and the value of John Brown's production is a simple matter, all that is necessary being to obtain a list of the work that John Brown did, to price this out at the rates for such work included in the standard costs and to compare the total so obtained with the amount paid. In the illustration given in Figure 5, the accounting is along even simpler lines than this, the production for a whole department being figured at standard rates and compared with the direct payroll of the department. To extend the plan, however, to show individual labor efficiencies would be a simple matter.

The plan illustrated in Figure 5 will be considered briefly both from the standpoint of the results obtained and from that of the methods necessary.

The results obtained from this plan are reflected in forms *K*, *L* and *M* as follows:

Form K. Summarized Manufacturing Statement.

This provides a comparison between the actual and standard costs of all manufacturing operations for the month and for previous months. Increases are shown in red and decreases in black and all data is analyzed under significant heads as follows:

Material by classes.
Labor by departments.
Burden by departments and general expense.

Form L. Adjusted Cost of Sales and Profit and Loss Statement.

This provides a comparison of the actual and standard cost of the goods shipped in the month, such costs being analyzed under the same arrangement as is provided on the Summarized Manufacturing Statement.

Form M. Current Cost of Machine.

This provides for obtaining the current cost of a machine by adjusting its standard cost to the basis of actual conditions by the use of the ratios of actual to standard cost of the various classes of material, labor and burden as appearing on the Summarized Manufacturing Statement.

To obtain the information enumerated above, it is necessary

1. For predetermined costs to be compiled of all manufacturing operations undertaken, the classification of such cost data conforming to that used on forms *K*, *L*, and *M*—namely:

Material by classes.
Labor by departments.
Burden by departments and general expense.

(The method followed in compiling the standard or predetermined costs is illustrated in forms *A*, *B*, and *C*.)

2. To provide means for obtaining the standard cost of all work done arranged under the classification followed in the compilation of the standard costs and in the Summarized Manufacturing Statement.

(This medium is provided in the Monthly Summarized Production Report—Form D. In this form the work produced in a department is extended at the labor and material rates as appearing on the standard costs.)

3. To provide accounts in which to summarize the information collected relative to the actual and standard cost of the various classes of material, labor, and burden.

(This requirement is met by the inventory accounts—Forms *E*, *F*, *G*, and *H*.)

4. To provide a medium for extending shipments at standard cost.

(This is furnished by Form *J*.)

Figuring Standard Costs

The figuring of standard costs is comparatively simple when the use to which such costs are put are known. For instance, one of the important advantages of standard costs is that by their use the cost of material in a machine, no matter when the cost was compiled, can be adjusted with facility to the basis of current conditions. In the case of the windstacker cost shown in Form *C* on Figure 5 it will be seen that the total standard cost of the lumber in the many parts of which this machine is comprised totals to $15.43. In obtaining the current cost of the lumber in this machine (Form M) by the use of the ratio of 116.7 per cent. of actual to standard cost of lumber, obtainable from the Lumber Work in Process Account (Form F), we obtain a current cost of lumber in the windstacker of $18.01.

In compiling standard material costs the following rules should be remembered:

1. Material should always be figured in standard costs at the same price.

2. The material classification adopted should be sufficiently detailed to provide for the ratio of actual to standard cost for a material class, as shown by the inventory accounts, representing approximately the ratio between the actual and standard cost of the material in that class for each important item of product.

As regards the first of the above rules, assuming that forgings, for instance, are purchased on a flat price per pound basis—it matters little from the standpoint of obtaining current costs of the forgings in a machine whether the standard price of forgings is taken as 10c. or 50c. a pound, so long as forgings are always figured in standard costs at the same price per pound. For instance, suppose that in Machine *A* there are 50 pounds of forgings and in Machine *B* there are 75 pounds, on the basis of a standard forgings cost per pound of 10c. the standard cost of the forgings in Machines *A* and *B* will be $5 and $7.50, respectively, and on the basis of 50c. a pound $25 and $37.50, respectively. Assuming that the actual cost of forgings is 15c. a pound, then the comparison between actual and standard cost would appear on the records as follows:

With a standard cost of 10c. a pound:

	Pounds	Actual		Standard		Ratio Per Cent
		Pound	Amount	Pound	Amount	
Purchases . .	5,000	.15	$750	.10	$500	150

With a standard cost of 50c. a pound:

	Pounds	Actual		Standard		Ratio Per Cent
		Pound	Amount	Pound	Amount	
Purchases . .	5,000	.15	$750	.50	$2,500	30

Using the above ratios in adjusting the standard cost of forgings to the basis of current conditions gives identical results as follows:

With standard cost of 10c. a pound:

	Standard Cost of Forgings in Machine	Ratio of Actual to Standard Per Cent.	Adjusted Cost
Machine *A*........	$5.00	150	$7.50
Machine *B*........	7.50	150	11.25

With standard cost of 50c. a pound:

	Standard Cost of Forgings in Machine	Ratio of Actual to Standard Per Cent.	Adjusted Cost
Machine *A*........	$25.00	30	$7.50
Machine *B*........	37.50	30	11.25

The importance of a sufficiently detailed classification of material costs depends very largely upon the character and variety of product manufactured. In some cases where approximately the same proportions of the different classes of material would be used in all the machines manufactured it would probably be found that approximately correct results would be obtained if all material were carried in one account and an average ratio of actual to standard obtained. On the other hand, it may be necessary to introduce considerable refinements in the classification, for instance, where in a small size machine the steel used might be practically entirely of base price stock while in a large machine it might be mainly of material with "extras." In view of the fact that the base price of materials is constantly fluctuating while the extras are rarely changed it follows that the use of one adjustment factor to cover variations in the cost of the material as a whole will result in an increase in the base price of material causing an overcharge to the machine using extras and a corresponding undercharge to the machine using base price material. For instance, suppose the standard base price of the steel to be, say, $2 and in the large machine all of the steel used to take an extra of 20c, the standard cost of the steel in these machines would be as follows:

	Base			Extras		
	Pounds	Price per 100 Pounds	Amount	Pounds	Price per 100 Pounds	Amount
Small Machine.	500	$2.00	$10.00			
Large Machine.	1,000	2.00	20.00	1,000	$0.20	$2.00

Assuming that the purchases during the period under review totalled 50,000 pounds at a base price of $3, 25,000 pounds of which represented extra price stock, a comparison of actual to standard would show as follows:

	Base	Extras	Total
Pounds.............	50,000	25,000	
Actual cost:			
Per 100 pounds......	$3.00	$0.20	
Amount...........	$1,500.00	$50.00	$1,550.00
Standard:			
Per 100 pounds......	$2.00	$0.20	
Amount...........	$1,000.00	$50.00	$1,050.00
Ratio, actual to standard....	150%	100%	147%

The adjusted cost of the steel in the two machines, assuming that no distinction had been made in the accounting for base and extras, would be as follows:

	Standard Cost	Ratio Per Cent.	Adjusted Cost
Small Machine....	$10.00	147	$14.70
Large Machine....	22.00	147	32.34

If, however, a distinction had been made in the accounting as regards base and extras the adjusted steel costs would be as follows:

	Base			Extras	Total
	Standard Cost	Ratio Per Cent.	Adjusted Cost		
Small Machine..	$10.00	150	$15.00	......	$15.00
Large Machine..	20.00	150	30.00	$2.00	32.00

So that, as was previously stated, unless the classification provides for distinguishing between base and extras an increase in price would tend to undercharge the machine not using extras at the expense of the machine using extras.

In actual practice it will rarely be found that this refinement in classification is necessary and as a general rule a classification of material under from 10 to 20 heads will meet all requirements.

(*To be continued*)

* * * *

EFFICIENCY—Stop! Look! Listen!

William H. Smyth

Consulting Engineer

ANCIENT habits of thought are so engrained in our modern mental fiber and thinking processes that few of us are aware of their existence, and fewer still realize how they modify and twist our customary thoughts. For, indeed, they unconsciously vitiate logical reasoning just as color-blindness and strabismus affect our physical sight.

Unless one is conscious of and continuously upon his guard against this besetting peril, almost inevitably will he be tripped by that stumbling-block to rational thinking. Thus, while it is interesting and instructive, it is not surprising to note how ancient habits of racial thoughts effect the discussion of "Efficiency": to note how almost all those who have countered my criticisms of the aims, purposes, and probable outcomes of the modern "Art of Efficiency" show the effects of this deep-seated influence; for my opponents' blows hit wide of the mark, and their arguments maul issues I have not raised.

A recent example is the discussion of Mr. V. J. Loomis anent my INDUSTRIAL MANAGEMENT September article, under the above title. Another equally good illustration is a pamphlet I have just received from an "efficiency" educational institution, which discusses my "Working Explosively" articles of last year.

There exists no more ancient nor more universal concept of human organization than that of autocracy—arbitrary CONTROL over other's thoughts and acts. The subtle influence of this fact is correspondingly great and far reaching. Even the most rabidly and insistently democratic individual—who *consciously* hates Autocracy and everything pertaining thereto, as the devil is said to hate holy-water—*subconsciously* thinks in terms of the hated but more *ancient* idea of government. And he is sublimely unaware how the ancient influence colors and distorts his superficially intelligent modern reasoning, how it blinds him to the quagmire of quaint self-contradictions into which he is being led by this mental will-o-the-wisp.

Notwithstanding that I believe in *efficiency* (as every sane person must), nor that I have repeatedly expressed this attitude in categorical terms, my opponents smash—with great self-satisfaction—not at me or at my views, but at a man of straw, a figment of their own imaginings, who disbelieves in and disapproves of efficiency *per se.*

When I criticize the "efficiency expert" and reprobate "that modern craze the Art of Efficiency," I do not and have no intention to question the desirability of true human effectiveness. On the contrary, I am directing attention to the *in*efficiency of the alleged "expert" and to the Human and National danger incident to the probable ultimate outcome of the so-called art. And I am earnestly protesting against a repressive and regressive method—a fundamentally vicious and suicidal idea of human life and Social Purpose.

And, *truly*, there never was a time in the whole range of human history when a clarifying of thought was more urgently needed than in this present year, day, hour, and moment—upon this all-important subject.

Mr. Loomis says:

> *To me efficiency means the best, easiest and most economical means of production.*

With this description I take direct issue; but I willingly admit that it expresses the *idea* and *ideal* of the "Efficiency Expert" whom I condemn.

Also, that it describes the motor "efficiency" idea of Germany, England, France and of the United States—*prior to* 1914—with the disastrous human consequences that Germany became a nation of slaves, England a nation of paupers, France quit breeding, and the United States went *product*—Wealth—crazy!

It is the idea which made it *necessary* for the United States to rise in arms and engage in bloody warfare—"to make the World Safe for Democracy."

It is an idea which has been in its ultimate results the most costly of all the errors which have blocked the path of human progress.

The idea means, in essence: The dethroning of high ideals, the debasing of *human personality* to a place below *products*—deifying the belly and body—*worshipping the Golden Calf!*

Efficiency, *surely*, is something quite different from all this; indeed the opposite is the truly modern ideal of efficient Democracy.

True efficiency implies not *"the best, easiest and most economical means of production,"* but the most effective method for liberating *Human Personality* to the freedom of democratic ideals of Self-government and to ever higher standards of *Self*-Realization.

In his last paragraph Mr. Loomis makes obvious the (to him) unconscious mental obsession of the old racial ideal of Autocracy by his unqualified approval of social conditions in which *"the two per cent. who are efficient will get double the portion of the entire ninety-eight per cent. who are inefficient."*

Clearly, he fails to realize that this means only one or two steps further in the "efficient" ninety-eight-per-cent.-elimination process and we would have: One Most efficient All Highest Autocratic Owner of the Nation!

This attitude of mind shows up a fundamental fallacy of the modern "efficiency" idea: Its reversal of a law of human development.

The reversal implies that human abnormalities are acquired for their possessor's own sole and exclusive advantage: that the "efficiency" genius, or the genius in any other direction has been endowed with his peculiar specialization for his own benefit.

The truth is just the opposite.

These exceptional ones are Nature's racial experiments, which, *if successful,* will benefit the race, or the nation in which they occur.

It is, however, the less differentiated "masses" which are the truly important element of the Nation—*not* its "sports" or its abnormalities, howsoever dazzling.

These exceptions to the norm are Nature's tentative efforts at racial improvement not "God appointed" conquerors or kings, kaisers or coal barons[1]—sent by Him to enslave, dominate, or *control* their fellows.

This "efficiency" notion is merely the old Cave Man's spiked-club-method of control by force and fear, disguised in modern trimmings. Its opposite is the truly modern Ideal of Democracy—Government of the people, for the people, by the people, for *Common*-weal.

One or two short quotations from the pamphlet—*"Efficiency and Humanity"*—to which earlier reference was made, will show with even greater clearness how thoroughly the modern "Art of Efficiency" is embued with the taint of Autocracy:

> "Control *is the essence of organization.* * * *
> .. *"Functional management consists in so dividing the work that each man from the assistant superintendent down shall have as few functions as possible to perform. If practical* * * * *a single leading function."*

In other words: The organization shall be a purely *mechanical* structure, each element of which has its own specific mechanical *function;* and the thus mechanically unified elements shall each efficiently contribute to effect the purpose determined by the *control* element; which control element *is the only really living, thinking, self-determining* human personality *in the entire organization*—a perfect exemplar of Autocracy, and totally anthetic to and subversive of the Ideals of Democracy.

And to what end or goal?—Products!

What shall it profit a man (or a Nation) if he—*with German efficiency*—gains the whole world of *products,* and, by this "efficient" *in*-efficiency, he loses his own Soul?

> "We shall defend Alsace-Lorraine with the last drop of our blood these provinces which belong to us and which the Almighty has entrusted to us to administer as His stewards, and we shall keep them for the benefit of their inhabitants and the glory of God." *From a recent speech of the German Kaiser.*

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[1] The Christian men to whom God in His infinite wisdom has given control of the property interests of this Country." —G. F. Baer, "Moving Spirit of the Anthracite Industry," *Reviews of Reviews,* Vol. 33, p. 547.

* * * *

Hazard of the Punch Press

Feeding a punch press is monotonous work. It consists of a series of movements which become largely mechanical in nature and which the operator learns in a short time to execute swiftly. In some light forming operations the experienced operator works with marvelous rapidity, frequently attaining a speed of 1500 or more operations per hour. For every single operation he may be required to place his hand or fingers close to the danger point or even in the danger zone itself. The human being is not infallible, and it is unreasonable to expect an operator to work at this speed hour after hour without sometimes breaking the harmony in movement of mind, hand and foot, which control the operation, thereby resulting in the loss of his hand or fingers.—*Industrial Commission of Wisconsin.*

Naval Aircraft Factory at Philadelphia

A Great Industrial Achievement of the United States Navy

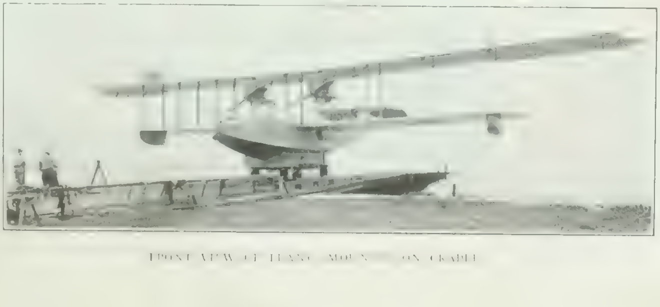
On July 27, 1917, Secretary of the Navy Daniels authorized the construction of the first and only government owned aircraft factory. Fourteen days later construction was begun at the League Island Navy Yard on a piece of land that was a little more than a country pasture. When the war closed this is what had been achieved: The plant had been constructed and equipped and a working force of nearly 4,000 persons had been recruited, materials and supplies had been secured and at no time has the production from the plant been behind schedule. The whole program was developed at a rate of which peace time offers no precedent or close comparison. Without doubt great credit for the result must be given to the system of industrial management that was installed to handle the multitudinous details of the enterprise. This indeed is an industrial achievement of the first order and one of which Americans in general can be truly proud.

THERE is an old saying that no piece of engineering work is complete until the story of how it was done has been told to other engineers. Now that the war has been won technical literature will be enriched by the stories of the great industrial achievements that have taken place during the last 18 months, and which for military reasons have remained generally unknown. One of the great pieces of industrial work done under the direction of the Navy has been the building and operation of the Naval Aircraft Factory at Philadelphia. The order for its construction was signed on July 27, 1917. Fourteen days later construction work was actually begun. On October 16 the first machinery was started in motion. Three weeks later the keel of the first seaplane was laid and in March, 1918 the first service machine successfully made its initial flight.

NAVAL CONSTRUCTOR FREDERIC G. COBURN, MANAGER NAVAL AIRCRAFT FACTORY

"Let us make our products so well and so fast that the only reason the public will have for investigating us is to find out how the 'hell we do it.'" (From one of his addresses to the entire Aircraft Factory organization.)

We often hear the saying that such and such a machine or plant was "built from the ground up," but not many engineers or industrial executives can interpret that expression with such literal exactness as Naval Constructor F. G. Coburn, the manager of the aircraft factory. To him belongs the great credit of planning, organizing and managing this difficult enterprise. He came to the task with a ripened industrial experience. After completing his naval education he was stationed for three years at Mare Island Navy Yard, California, during which time he began a study of scientific management. For the three following years he was superintendent of one of the principal departments of the Philadelphia Navy Yard. Then came three years at the Boston Navy Yard on similar work, one of the outstanding features of which was the development of the process of making heavy cable chain, which has since been in continuous successful use. He also gave considerable time to investigations of private plants.



FRONT VIEW OF [illegible] ON CRADLE

THE ORIGINAL AIRCRAFT FACTORY

To meet the interest and needs of the readers of INDUSTRIAL MANAGEMENT a somewhat detailed description is given in the following paragraphs of the plant as a whole and of each one of its principal buildings.

The original Naval Aircraft Factory building, although it was wanted as rapidly as possible, was designed as a permanent structure of brick, steel and glass, because the time necessary to obtain materials and necessary equipment for building planes was more than was required for the construction of the building itself.

As built, it is a square building 400 by 400 feet in dimensions, divided into two parts. The one—300 by 400 feet in size—is an Austin standard No. 3 factory building. In this are located the two fundamental producing departments (metal shop and saw mill) and the panel assembly, varnish and dope rooms. As originally built, this building also contained the main store-room for the plant. It was further sub-divided by a fireproof steel and wire glass partition into a 100 by 300-foot section in which were locker and wash room, (a locker for every employee and plenty of toilet facilities) a cafeteria large enough to feed 500 people every half hour; a section approximately 150 by 60 feet in size used as the office, and one about 80 by 40 feet for the drafting room. The other part used as the boat shop is 400 feet long and 100 feet wide and was especially designed in order to accommodate large flying boats, and high enough to allow of a ten-ton crane with a 40-foot hook lift. This was necessary because the dimensions of a finished boat are over 100 feet wing spread and 50 feet boat length. The finished boat weighs seven tons and stands over 17 feet off the floor while being assembled—this fixed the height of the crane which was necessary in order to lift one boat over another.

The type of building chosen was capable of being very rapidly built, beneficial occupancy being obtained in 60 days after ground was broken, and the whole low part of the building having been erected in 90 days. The floor chosen was wood over cinder fill and wood sleepers over concrete base. This was because the location of the machinery would often be subject to radical revision, as the type of plane or production capacity changed, and this type of floor would allow quick erection and easy shifting of machinery. The building also has as few partitions as was consistent with fire protection, in order that shops would not be hampered should their growth be uneven. This provision was afterward proved to be very wise for it was necessary to make several radical changes in the layout of the shops when the plant was increased.

The remainder of the original factory building equipment was a

UPPER—GENERAL SIDE VIEW OF HULL
MIDDLE—PROPELLERS IN COURSE OF CONSTRUCTION
LOWER—PANEL ASSEMBLY SHOP, PLANT NO. 1

UPPER PLANT NO. 1, BIRD'S EYE VIEW IN HIGH SHOP
MIDDLE PLANT NO. 2, FINAL ASSEMBLY
LOWER SIDE VIEW OF HULL BEING MOVED BY CRANE

temporary boiler house (built of frame and sheet iron), dry kilns and a heated lumber storage. The last building was necessary in order to provide a place for storing wood that had been kiln dried before it was requisitioned by the mill. The building was simple in construction, consisting of a brick building about 60 by 100 feet in size with a wooden roof supported by steel trusses. Only sufficient heat was provided to keep the temperature of the building above dew point.

The dry kilns are of the Tiemann type. There are four cells and a joint operating chamber. They are constructed of brick, hollow tile and steel and are a permanent installation. The provision of these kilns was necessary because of the now well known fact that aiplane lumber must be seasoned before use, and the supply of air dried lumber of the dimensions such as used on flying boats was not sufficient to meet the needs of production.

A word might be said here about the air conditioning equipment of the shops. A system of ventilation was installed by which the shop was not only heated, but the air in it kept automatically to the proper degree of relative humidity to prevent either the checking or warping of dried lumber, and to provide that wood reaching the assembly building would have the same dimensions as when it left the mill.

This plant, as described, had a capacity of one boat a day. When, late in December, the Navy Department decided to increase the production of the plant to four times its capacity, plans were drawn as rapidly as possible. The policy proposed for the increased program was to have parts for small assemblies made both in the old Aircraft Factory and in plants of other boat builders and shops capable of turning all or part of their equipment into airplane producing machinery. These sub-assemblies were to be brought to the Naval Aircraft Factory and there assembled in a large assembly room, using progressive assembly. By this means it would be possible to achieve production more rapidly than if it had been necessary to build up the producing departments of the factory, with the attendant increase in equipment and labor. The new factory building was therefore designed to be an assembly plant solely.

It is interesting to note that the request of the Navy Department for more boats was dated December 26, 1917, and on January 12, 1918, a layout of the new building was ready, which, without serious modification, was the one eventually used. It was not possible to enlarge the original building because, although it had been recognized in designing it that it would probably have to be increased at some future time, it had been necessary to locate it in such a position that all enlargement be to the eastward and south as there was the only vacant ground.

A study was made of the best possible arrangement. After over a hundred layouts has been plotted, it was decided that the best arrangement would be to extend the avenues on the north and south of the original factory as a base. This made a block 400 feet wide which could be extended as far eastward as desired. A 75-foot street was left and on this, facing the old factory, were placed a 200 by 180-foot storehouse occupying the northern half, and an office building 180 by 120 feet in size in the southern half, thus leaving a small separating alley running parallel to the two avenues. Another 50-foot street was left and then came the assembly building itself in two parts—one, a low part 350 by 400 feet in ground size, occupying the space between the two avenues, and the other, the high shop, 680 by 200 feet on the ground, extending southward to the river. This high shop started 150 feet east of the corner of the street last mentioned and the southern avenue. This made the building the shape of an inverted L with the long side running north and south and farthest away from the old factory. After traversing the small courtyard formed by the base of the L, the southern avenue was stopped.

A detailed description of these buildings follows:

THE STOREHOUSE

The storehouse is 200 by 180 feet on the ground and six stories in height. It is a modern fireproof, reinforced concrete building. It has served several features worth noting in its layout which are best understood when the various functions of the storehouse are described. Primarily, it was built to store individual parts before assembly, whether made in the factory or purchased outside; to care for raw materials, such as sheet or bar steel, metal tubing, etc.; all aviation ordnance equipment was to be stored, in addition to articles necessary to pack the finished boats, such as nails, tar paper, etc. It was to serve as a base of supply for all Naval air stations and would hence require proper shipping facilities for either small or bulky parts. It would also have to serve as a receiving depot and would get its material from three sources: railroad cars for material brought long distances; trucks for that from nearby factories; and small hand trucks for intra-factory traffic.

To provide for this receiving function, the building was designed to have a platform 10 feet wide on three sides at car level and the grade of the first floor was likewise placed at this level. On one side there was a railroad track, and on two of the other sides a wide street was left to allow trucks to back up without interfering with traffic. These two sides were parallel to the old factory on one side and the long side of the new factory on the other. There was provided an entrance door on each of these two sides with a ramp to the street to allow either hand trucks or electric tractors to enter and leave without the necessity of an elevator. These doors were set in line with the main entrance of the old and new shops and also in line with each other, thus leaving a 20-foot aisle clear through the building. Four elevators were provided, one in the middle of each side containing a platform and two on that side having the railroad track. The side facing the office building was left blank and a narrow street left, over which, at the second floor level, a bridge connecting the office building and storehouse was built.

On the three sides containing the platform folding doors were provided in every other bay. The elevators were so placed that one door was on the platform and the other on the inside of the building. A circular inclined chute was installed similar to that used by large grocery warehouses. This was to enable the many different size parts to be collected easily at one point and made ready for shipment. The first floor was divided by a partition into a receiving and shipping room. In each corner there were small offices. The upper floors were not divided off except that in one corner of each floor an inspection room was provided approximately 80 by 40 feet in size. These inspection rooms were provided as it would be necessary to heat them to a living room temperature, the rest of the storehouse being heated only enough to keep its temperature above freezing.

THE OFFICE BUILDING

The necessity of an office building grew out of the fact that a large clerical force was required to handle details of organization which, at its full capacity, would have had 6,000 employees, and also because the production of the sub-contractors was also handled from this central office and their employees totaled seven or eight thousand more. Further, the engineering problems of a large aircraft factory required a large drafting force, chemical laboratory and other engineering equipment. The accounting and purchasing departments also required large organizations.

A reinforced concrete building of pleasing architectural design consisting of plain concrete exterior on the first floor and continuation of concrete and brick on the upper floors was designed. The building itself is built in the form of a U, each wing being 60 feet wide and 60 feet long. On the first floor, one wing is given over to offices for the principal executives and the other wing is divided between the production office and employment department. The central portion of the building on this floor is used as an entrance lobby. On the second floor one entire wing is given over to the supply department and the other was divided between the accounting department and plant engineer's section. The entire third floor is used by the engineering department, one wing being laid out as chemical and physical laboratories, photographic dark rooms and wood testing laboratory. The north wing is the drafting room and the connecting base contains the blueprint room, files, etc. Locker rooms are provided for men and women on the second floor. A ladies' rest room is also part of the service equipment. The short side facing the courtyard formed by the U is divided into three sections: in one is placed the women's toilets, the next is the staircase well with an elevator, and then next the men's toilet room and charroom. This arrangement is duplicated on each floor. As mentioned above, on the second floor a bridge connects the supply and purchasing department with the storehouse, which is controlled by that office. A vault is provided on every floor. The building is heated and ventilated by washed air blown to the various rooms through hollow columns. This is supplemented by direct radiation placed near the windows.

THE ASSEMBLY BUILDING

Although under one roof, the assembly building is divided into three main sections—a low part (similar in construction to the old aircraft factory) 300 by 400 feet; a section 50 feet wide and 400 feet long and 30 feet high with a traveling crane (the placing of the columns in this building is similar to that of the first factory, namely, spans of 50 feet one way by 20 feet in the other direction); the other section of the building was designed for progressive assembly of hulls and consisted of three bays, the central one of the same dimensions as the high shop of the original factory, but 680 feet long instead of 400 feet. This was flanked on each side by a bay 50 feet wide and 30 feet high. One of these two bays was a continuation of the panel assembly bay mentioned above. Each of the side bays is provided with a 5-ton and the center bay with a 10-ton traveling crane. The purpose of this construction was to allow the sub-assemblies to be made in the side bays and the main assembly in the central bay. A railroad track was provided in each end of the building.

The flow of materials was so arranged that the smaller parts would come from the storehouse and into a 20-foot door set opposite the storehouse ramp and thus into the panel shop, where the great majority of these parts were used. Larger parts would be received either by rail or truck directly into the assembly shop. The panels as assembled moved across the bays of the L and were covered, varnished and doped and then arrived in that section of the building reserved for the wing jig assembly. From there they were taken down along the long side of the L to the extreme end where they were crated, packed and shipped. Meantime, the hulls (which had been received by rail at the one end of the high shop) were progressing in the same direction and met the panels when they arrived in the shipping room and were crated and packed. The whole unit was then loaded on cars and shipped out of the building—and either shipped by barge to the port of embarkation or actually loaded on board ship in the Navy Yard for shipment overseas.

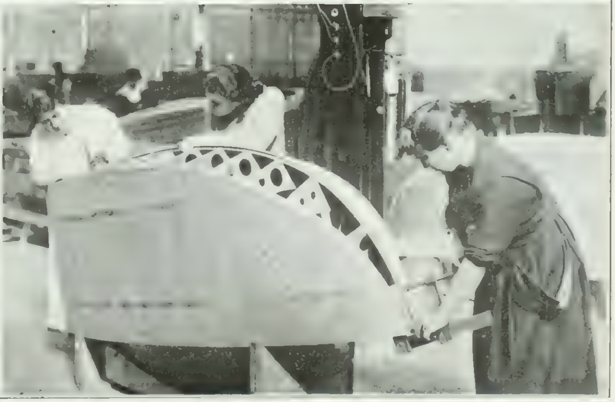
This building was constructed on the same general lines as the original factory, but with several improvements which had been learned in the construction of the older building, such as the placing of all toilets and heating apparatus in the roof trusses in order to keep a perfectly clear floor space, and the columns and footings on the long side of the building containing the 30-foot high bays being so designed that the building could be easily enlarged should it ever be decided to balance the plant and manufacture all parts on the premises.

THE BOILER HOUSE

In order to provide steam with which to heat the various buildings and operate the dry kiln, it was necessary to provide a boiler house. One large enough to hold six 750-horsepower, water-tube boilers was designed with all modern coal and ash handling apparatus and automatic stokers.

Power used in the plant is alternating current, 3 phase, 60 cycle supplied by the Navy Yard with a breakdown service from the Philadelphia Electric Company. As the power demands of the factory increased, it became necessary to use the latter entirely. A transformer house was built across the street from the original factory building, from which the current was distributed to the various buildings, using the same cables as those originally laid out for use by the Yard.

ABOVE—GIRL MAKING OXY-ACETYLENE WELD
BELOW—GIRL DRILLING METAL FITTING



ABOVE—GIRL DOING HEAVY FILING
BELOW—GIRLS PLACING SIDE PLANKING ON PONTOONS

The Garage

To overcome the increased difficulty of obtaining materials, due to the congestion of the railroads, and to provide proper facilities for handling materials from the various contractors in and around Philadelphia required the use of a large number of automobiles and trucks. A garage was therefore constructed to house them. This building (140 by 60 feet) consisted of brick, steel and glass framework and a gypsum slab roof.

To provide for the increased demands for lumber, it was also necessary to increase the capacity of the dry kiln and heated lumber storage.

The Seaplane Hangar

As the experimental work of the factory expanded, the amount of test flying increased very rapidly. To this end a steel hangar, which is believed to be the largest of its kind in the world, was designed and is now in the course of construction. This building will be 200 by 150 feet on the ground and will have a clear span of 200 feet and be 50 feet from the floor to the bottom chord of the roof trusses. In front of it will be a concrete apron 200 feet square. From this will be a ramp 40 feet wide extending into the Delaware River approximately 200 feet. There will be 10 feet of water above the end of this ramp at low tide, which will provide ample draft for flying boats of any conceivable size.

Fire Protection

The fire protection of the Naval Aircraft Factory is worthy of note. All of the buildings are provided with automatic sprinklers. Fire walls divide the shops containing a fire hazard from the rest of the factory. In the orginal factory a hollow tile fire wall divides the high shop from the low in order to prevent the formation of a dangerous draft should fire break out in the low section. The same plan was followed in the new assembly building, a brick wall separating the high bays from the low.

In addition to the sprinklers, hose lines are placed at convenient points, and hand extinguishers, fire pails, etc., are found throughout the shops. Fire drills are held semi-monthly. Pressure is maintained on the sprinkler lines by means of a 100,000 gallon tank 150 feet high now in the course of construction and by an electric fire pump arranged to start automatically whenever the yard water pressure fails below the danger mark. The entire property covering over 40 acres is constantly patrolled by watchmen and there are also trained firemen on every shift. A regular monthly inspection trip is made by the factory officials and foremen are either complimented or reprimanded for the cleanliness of their shops.

Plans had been drawn for a storehouse for inflammables, located in an isolated part of the yard, and also for a building in which were to be concentrated all processes such as heat treating, brazing, etc., which presented an undesirable fire risk. Summed up, it was the intention of the management to have the plant measure up to the good risk standard of the Associated Factory Mutual Fire Insurance Companies.

Employment Management

It is a pleasure to give testimony to the low labor turnover that the Aircraft Factory has had during its existence and to the general satisfactory calibre of the employees secured under Civil Service regulations. On November 1, 1918, there were 3,642 men and women employed. To secure this force it had only been necessary to hire a total of 6,035 persons, truly a remarkably small number compared with the record of many private establishments making war material, and particularly the shipyards of the country. It has often been necessary in private plants during the period of war to hire ten persons before a satisfactory employee was secured. Still another significant fact is that only 139 persons had been discharged for cause since the factory has started. And this point must not be forgotten that not more than 25 among all the persons hired had ever had any previous experience in an aircraft factory.

From the very start women were employed and they have made good. Much of the success of the work done in the factory is due to them. At first they were only engaged for clerical work. In December, 1917, a few entered the inspection department to inspect screws, bolts, turnbuckles and small metal parts. In other departments some previous experience and skill were necessary so a training school for women was opened in May, 1918. The following table shows the increase of women employees since this school was opened:

Month	*Employees*	*Women*	*Per Cent*
June	2302	218	9.4
July	2068	203	9.8
August	3133	468	14.9
September	3295	590	17.9
October	3550	710	20
November	3640	895	24.5

And finally women have assisted in the management of the plant for the Naval Aircraft Factory as three forewomen are employed, one in the inspection department, another on filling, varnishing and painting, and the third in charge of the drill presses.

* * * *

"I think it may be truly said that two facts become increasingly evident in connection with our industries as the war situation develops in this country. The first is that every industry whose products can contribute directly or indirectly to carrying on the war will be operated under intense strain. The second is that as the draft progresses and men are called to arms there is likely to be an influx into the factories of inexperienced persons, including probably many women, unfamiliar with the industries in which they may become employees.

"There is a real danger, therefore, that in our sympathetic and proper thought for the soldier in the field we may lose sight of the soldier in the factory, who has his casualty risks as well as his brother in arms. May I therefore express the hope that through your publication an earnest effort may be made to see that not only are the safeguards for life and limb provided by laws maintained in full force and vigor, but that a special appeal is made to our leaders of industry to safeguard by careful provision and constant thought the lives of the toilers now so necessary to our country? We must, we fear, face two casualty lists in the coming days—one in the factory and one in the field; but surely it should be possible to take such steps against the known and controlled dangers of the factory as will prevent the increase of that death list and possibly diminish its present length.

"Just as there is a call to service for the soldier and the financier and the nurse and the doctor and the engineer and the mechanic, there is a call to service in his own office and his shop to every manufacturer to see that the precious lives of the country are not wasted and that the bodies of the precious people who make up this country are not crippled."—Hon. Wm. C. Redfield, Secretary of Commerce, to Editor of "Safety Engineer."

Paved Roadways Aid Plant Efficiency

By H. Colin Campbell

This article is a plea for better roadways around factory buildings both for the use of motor and industrial trucks. Resistance to starting a load sets the limit of that load. Stalling and starting loading trucks produce wear and tear and breakage of equipment. Suggestions are given for the construction of concrete surfaces for plant roadways and drives.

Mr. H. Colin Campbell *is a graduate of Columbia School of Mines in 1887, College of Physicians and Surgeons in 1897. He was engaged as mining and construction engineer by a number of railroad and other large concerns in the United States, Mexico and South America. He is a contributor to a number of leading magazines, both technical and semi-technical, and is the author of many pamphlets, a number of which have served as chapters in correspondence school courses.*

MOTOR trucks and horse-drawn vehicles can carry only as much as the motive power can start, and how much of a load can be started depends almost entirely upon the roadway or drive surface. Efficiency demands that all industrial driveways be paved with a durable, mudless, dustless, wearproof surface so that useless and wasteful expenditure of energy and fuel, as well as wear and tear on vehicles, be eliminated. Those who improve their plant drives to satisfy this demand are amply repaid in the greater efficiency that accrues to plant operation, with respect to ease of access in hauling in raw materials and equally easy egress in shipping manufactured products. Hardly an industrial plant can be considered an exception.

There are a number of reasons that deserve particular consideration as to why plant drives should be paved. There is no lost time on any occasion because of teams or trucks stuck in the mud, or because of overloading of vehicles. Any load that the vehicle can stand can be moved by the motive power if it is sufficient, since the even, paved surface— particularly if concrete is used—offers insignificant resistance to traction.

Breakdowns and consequent repairs are due largely to the stalling of heavily loaded vehicles and the tugging and jerking to which they are subjected in attempts at starting. Such repairs, not to mention the delay caused by them, are costly.

The solidly paved drive is in business 365 days a year. Neither weather nor season can cause traffic delays. Snows can easily be removed and rains have no effect on a surface of this nature.

PLANNING DRIVEWAYS

The ideal driveway should be planned with a view to the nearest possible approach to permanence so that it will stand the heaviest traffic with little or no wear, presenting an even surface opposing the least possible resistance to traction; should have an even surface to provide quick, free drainage; should not be slippery; should not be high in first cost nor require costly maintenance.

In adapting concrete to this use the same methods of construction apply as to concrete street or highway pavements. It is impossible to build good driveways out of poor material or with poor workmanship, yet it is possible for plant labor to do the greater part, if not all of the work, provided good materials and workmanship are used under competent supervision. Clean, hard, durable materials must be used for aggregates. Hard pebbles, screened from a gravel deposit, or hard crushed stone serve for coarse aggregate. Hard, well graded sand or granite screenings can be used as fine aggregate, but material taken from the ordinary gravel bank should not be used until screened, so that the fine and coarse materials can be separated and reproportioned in definite volumes.

Concrete can be laid directly upon a properly prepared subgrade, which should be brought to a firm, unyielding bearing at all places by thorough compacting, preferably by a ten-ton or heavier roller. Soft, unstable spots in the subgrade should be dug out and refilled with clean, well compacted gravel or cinders. Every precaution must be taken to insure that the subgrade or foundation for the pavement is well drained, otherwise there will be settlement or heaving somewhere that eventually will result in cracks in the slabs. While ordinarily these are not objectionable except from the standpoint of appearance, it is just as well to avoid them by proper precautions at the commencement of the work—and concrete paving begins when the first steps are taken to prepare the foundation.

A CONCRETE DRIVEWAY PERMITS THE USE OF AN INTER-DEPARTMENT MOTOR FOR THE RAPID TRANSFER OF MATERIALS AND SUPPLIES BETWEEN THE VARIOUS BUILDINGS OF A PLANT

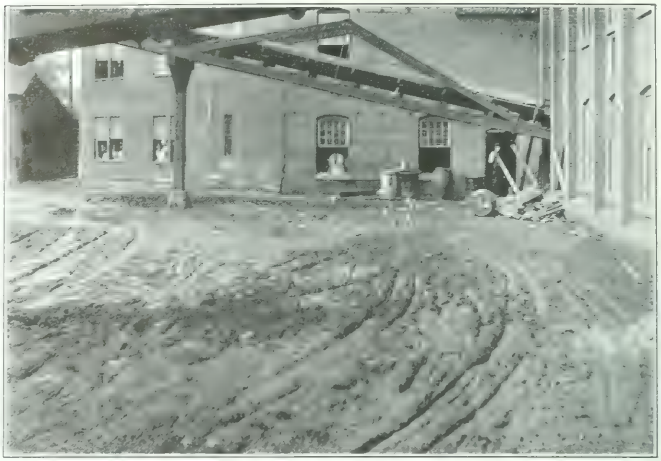
General Chemical Company, Edgewater, N. J.

CONCRETE DRIVEWAY PAVEMENT AT THE PLANT OF THE NATIONAL ARTIFICIAL SILK MILLS, CLEVELAND, OHIO

In many instances, instead of crowning the pavement as is done with street and road pavements, the surface is dished, thus causing drainage to flow to and along a center line where connections are made to water outlets. To obtain the required contour, a strikeboard is needed to strike off the concrete after deposited to the proper depth on the subgrade.

THICK SLABS ADVISABLE

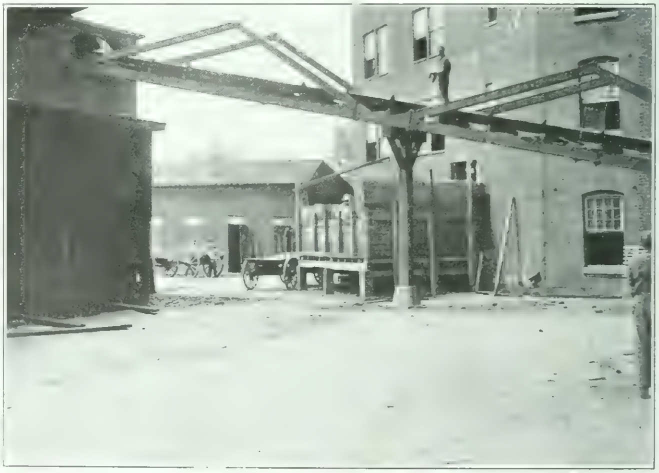
With heavily loaded trucks becoming more and more common, it is advisable that a departure be made from the commonly accepted practice of two or three years ago with respect to pavement thickness and that the concrete slab be made everywhere at least eight or nine inches thick, and preferably reinforced with mesh fabric or rods. It must not be supposed that an 8- or 9-inch industrial driveway pavement is recommended as suited to all possible industrial motor truck traffic. There are a number of instances where drives have been paved with from 12 to 17 inches of concrete and with present-day loads of 10 tons or more, it is conceivable that much heavier ones will before long oppose their weight and destructive tendency to roads, streets and alleys.



CONDITION OF YARD DRIVES AT PLANT OF THE STANDARD FURNITURE COMPANY, HERKIMER, N. Y., BEFORE PAVING

Most concrete pavements are of what is known as one-course construction, which usually consists of a 1:2:3 concrete mixture that is laid at one operation to the entire thickness of the proposed finished slab. After being struck off to the required contour, the surface is rolled with a light roller to compact the concrete evenly and remove excess water from it, following which the required finish and surface texture is given by see-sawing a wide canvas or rubber belt back and forth and forward across the surface. Usually two operations of the belt are all that is required.

In plants having scattered buildings, connecting concrete paved driveways permit operation of small inter-department motors for the delivery of materials and supplies to the various buildings and departments. They will effect great economies in the expense of moving the materials and supplies about the plant. And this movement can be carried on with such precision and certainty that the scheduled time allotted for the passing of a piece of work through the plant may be materially reduced, thereby reducing the cost of production.



CONDITION OF THE DRIVEWAY AT STANDARD FURNITURE COMPANY PLANT, AFTER BEING PAVED WITH CONCRETE

Concrete paved drives are a great incentive to orderliness. As soon as built a decided improvement is at once evident in the plant surroundings. Rubbish piles disappear. The driveway which formerly was a free-for-all scrap yard assumes the appearance of a street. This orderliness results directly in a greater economy of materials on the part of those who use the driveway and indirectly on the part of every employee, by reason of the sense of order inspired in them by the general appearance of the plant.

A concrete paved driveway is sanitary and cleanly. there are no holes or pockets in which stagnant water or refuse or rubbish will collect. The pavement can be easily swept clean or flushed and will always be in a sanitary condition. If grease or oil should be spilled on it, it can be swept or scraped off and there is no danger of the pavement absorbing any of it.

The pavement which is usable 365 days of the year is a decided factor in fire-safeness of a plant. Fire equipment may be easily and quickly moved anywhere about the plant. With fire hydrants conveniently located along the driveway, fire equipment can get anywhere quickly and the fire protection of the plant will be greatly increased. The two illustrations on this page show in a striking manner the contrast between formerly existing conditions and a well-concreted roadway.

Electrostatic Dust Precipitation

A New Process that Solves the Perplexing Industrial Problem of Dust and Fumes

By William H. Easton

Fine vertical wires are charged to a very high potential by means of direct current at from 50,000 to 100,000 volts pressure. Around each wire is a tube that is grounded so that a strong electrostatic field is set up inside the tubes. The dust laden gases pass upward through this field becoming ionized and when charged to the polarity of the wire, which is much higher per unit area than the tube, the dust particles are attracted to the walls of the tubes where they adhere, are jarred off and collected. This process has numerous industrial applications. Mr. William H. Easton *after completing his scientific education at the University of Pennsylvania was appointed chemist to the Bureau of Surveys in Philadelphia. He later entered the employ of the Heany Fireproof Wire Company, York, Pennsylvania, and became sales manager in 1908. He accepted a position on the editorial staff of the Westinghouse Electric & Manufacturing Company, which he has since held.*

THE appearance of an entirely new industrial process is a rare occurrence. Progress consists mainly in improvements to existing apparatus and in extensions of long used principles; so when a complete novelty, such as the steam engine or the electric motor, does appear, its effect is apt to be revolutionary.

Whether the principle employed in the electrostatic method of dust precipitation has sufficiently far-reaching industrial possibilities to be in any sense revolutionary or not, remains to be seen. It is at all events unlike anything employed heretofore in commercial work and provides industry with a new instrumentality. Its applications will doubtless be greatly extended in time, but at present it is used chiefly for the collection of dust particles.

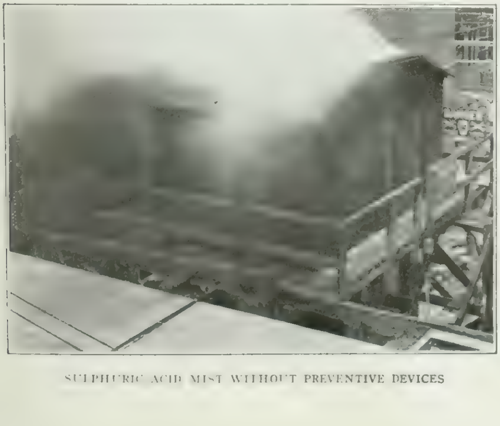
Dust has always presented a perplexing industrial problem. The clouds that pour from cement mills, blast furnaces, smelters, and many other kinds of plants, not only represent a waste of valuable material, but cause countless troubles in the plant, injure the surrounding country, give rise to unending lawsuits, and banish any industries into the wilderness. Numerous chemical and mechanical methods have been devised to suppress dust, but none has heretofore been generally applicable, especially when very fine dust is to be handled. The electrostatic process has, however, proved to be highly successful.

One of the interesting features of the process is that, though developed solely to prevent a nuisance, it frequently proves most profitable financially. A copper-smelting company, for example, installed a precipitating plant at a cost of $113,900. The operating expenses (power, labor, supplies, etc.) were $14,600 a year; but the value of the copper dust collected was $180,018 a year (all figures based on pre-war prices), which certainly represents a satisfactory profit. Cement plants can also show a good return even on such low-value material as raw cement dust, but of special importance is the fact that many cement plants can collect many tons of potash per annum, which is valuable at all times and immensely so at present. One cement plant, with a precipitating equipment that cost $180,000 to install and $10,395 a year to operate, obtained recoveries of cement dust worth $25,000 and potash worth $50,000 a year (also pre-war prices).

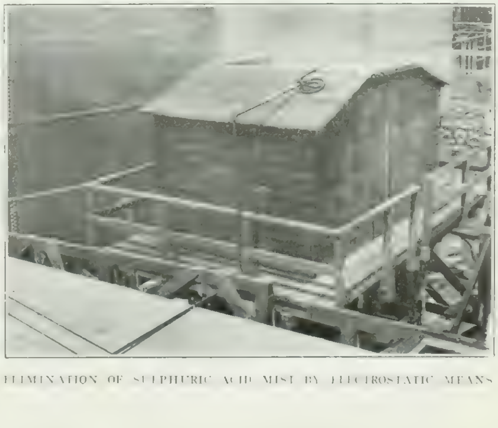
This process is in practical service for suppressing the dust from rock crushers; removing dust, tar and soot from illuminating gas; suppressing the smoke from locomotive round-houses and other places where mechanical stokers cannot be used; and collecting the fine powders produced in the manufacture of lamp-black, desiccated foods, and the like. It is also applicable to the removal of fine drops of liquid carried in gases, and so finds use in removing acid fumes from the emissions of chemical plants. It appears applicable wherever problems due to fine suspended particles arise.

Principle of the Process

Though the electrostatic method of dust precipitation is new, the underlying principle is as old as the hills. Rub a rubber comb against a woolen garment and the comb, becoming electrified, can attract and hold scraps of paper and other small particles. This is the phenomenon on which the process is based.



SULPHURIC ACID MIST WITHOUT PREVENTIVE DEVICES



ELIMINATION OF SULPHURIC ACID MIST BY ELECTROSTATIC MEANS

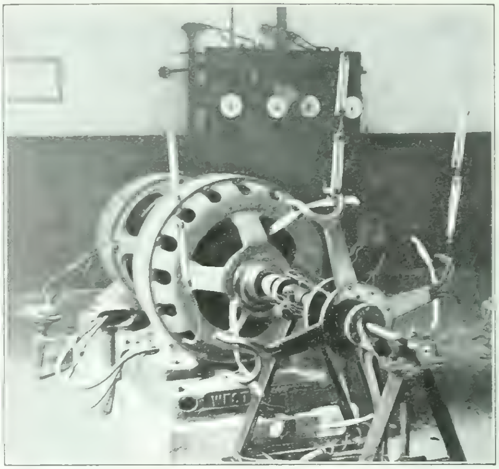
PRECIPITATION TUBES, COTTRELL PROCESS

Scientists discovered some years ago that if a gas carrying small solid particles was passed through an intense electrostatic field, the solid particles would be precipitated. This principle was used in the study of the material emanations from radio-active substances and was suggested by Sir Oliver Lodge as a possible means of clearing away London fogs. No practical use was made of the method, however, until Dr. Cottrell, now of the United States Bureau of Mines, saw the industrial possibilities that lay in it and developed the present process, which is generally referred to as the Cottrell process.

A typical Cottrell treater for precipitating the dust carried by gases, consists of two large horizontal pipes connected together by means of a large number of small vertical tubes. Inside each tube hangs a fine wire, which is charged by means of direct current to a very high potential—from 50,000 to 100,000 volts. The tubes are grounded so that a strong electrostatic field exists inside the tubes.

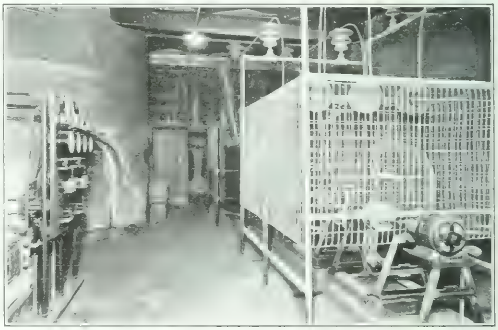
The dust-laden gases from the cement kilns, furnaces, or other source, pass into the lower pipe, up through the tubes into the upper pipe, and thence out through the stack. When they strike the electrostatic field within the tubes, the gases become ionized, and since the area of the central wire electrode is much less than that of the tube, the stresses around the wire are far greater per unit area and the ions become charged to the same polarity as the wire. This charge is in turn transferred to the solid dust particles, and these are attracted to the walls of the tube, where they adhere until the tube is jarred or hammered by a mechanical device, when they fall into hoppers below. When properly designed, a Cottrell treating system can remove about 95 per cent. of the dust or liquid content of the gas passing through the tubes composing it.

The Electrical Equipment



HIGH TENSION TRANSFORMATION APPARATUS FOR PRECIPITATION

Direct current of 100,000 volts was, of course, entirely unknown to industrial electrical engineering when this process was first developed, and some entirely new apparatus had to be designed in order to reduce the method to practice. After considerable experimentation satisfactory equipment was finally devised and standard Cottrell apparatus is now being built by several electrical manufacturers.



PROTECTED HIGH TENSION APPARATUS

The primary source of power for a Cottrell treater is low-voltage alternating current of 25 or 60 cycles. This current is fed into a special transformer which steps it up to the desired high voltage, after which it goes to a rectifier, which transforms the high-voltage alternating current into direct current of the same voltage.

The rectifier consists of four stationary contacts and four arms, each bearing a contact, which are revolved in synchronism with the current being transformed. The principle is the same as that of the commutator of a direct-current generator, which transforms the alternating current generated in the armature coils into direct current.

The low-voltage alternating current can be derived either from the power lines of the plant or from separate motor-generator sets. The first method is lower in first cost than the second and is frequently used; but the second is, in general, considered better practice because the power circuit and the Cottrell circuit are then electrically independent and trouble arising in one circuit does not spread to the other. One generator can be used to supply power for the entire treater but it is usually preferable to arrange the Cottrell tubes into a number of independent units, each having its own generator, transformer and rectifier, so that one or more units can be closed down for cleaning, repairs, etc., without interfering with the operation of the remainder.

There are two methods of driving the rectifier. When motor-generator sets are used, each rectifier is mounted on the shaft of its generator and is thus mechanically kept in step with the current it is transforming. When the current is taken from the power line,, the rectifiers are driven by synchronous motors which necessarily keep in synchronism.

The transformers used in this service must be of special design and construction. Not only are the normal voltages high, but surges of much higher voltage are apt to develop in the treater circuit and be reflected back through the apparatus. (The possibility of the occurrence of these surges is one of the reasons why it is advisable to separate the treater circuit from the power circuit). To check these surges as far as possible, choke coils are built within the transformer. Large condenser-type terminals are used to prevent grounds at the transformer case, and the transformer coils are heavily insulated. As a result of these protective measures transformers for the Cottrell process are much larger than ordinary power transformers of the same voltage and capacity.

The transformer is arranged so that the voltage of the outgoing circuit can be varied from 50,000 to 100,000 volts in several steps. This is done by connecting the incoming low-voltage current to any of several taps with low-voltage windings, and is necessary because the most satisfactory voltage for use in the treater tubes varies with the character, temperature, and speed of the gases and with barometic conditions, and the voltage must be altered with any change in these factors. Means are also provided for varying the voltage of the incoming current, thereby permitting small variations in the voltage in between the large steps provided by the transformer.

The high voltage circuit is kept as simple and free from connections as possible. All instruments, circuit-breakers, switches, etc., are connected in the low-voltage line.

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Industries and Education After the War

By E. H. Fish

Director of Employment, The Norton Company

THE conscience of the country was fully satisfied after the Civil War by the erection of a huge system of pensions. The only way in which we could think of compensation for suffering and loss of limb and faculties was in terms of money. The recipients were in too many cases of the same frame of mind. The result was that we were cursed for years with an army of tramps, not by any means all veterans, but living on the reputations which the latter had made.

Today, however, we are looking on this matter in a quite different way. We realize the need of money, and are providing for it generously, but we also realize that it is unnecessary for us to have a great scrap-heap of broken men, whose plea, that the country owes its safety to them, is an excuse for their no longer being useful citizens. We realize that no matter how badly mutilated the body, if the brain is clear, there is useful work that can be done and should be done for the continued sanity and bodily health of the unfortunate soldier. The problem is not whether we should try to help these men to be of use to themselves and the world, but how.

We have in prospect a considerable number of men, once of the greatest physical strength, now weakened by suffering, young for the most part and not beyond the age of being receptive to new ideas and new methods of precedure. They are of every degree of mental ability, of every race, from every trade and profession. Many of them have had much less education and training than they could have profitably absorbed. As a whole they were undoubtedly doing work much below the grade to which they might have been trained if the opportunity had been presented and they had been receptive. As a whole, then, they are probably capable of being trained for work of a higher grade than they were doing before they went to the front.

PROBLEM FOR MANY IS SIMPLE

For a large portion of these people the problem is rather simple. Men who were in the profession can for the most part resume their work, with a handicap to be sure but not an insurmountable one. The more purely physical their previous endeavors in the past the more likely is their disability to prove to be a real handicap. A man who was a brick-layer and has lost an arm and a leg will find himself worse off than a lawyer who has suffered much more severe losses even to total blindness. A machinist can find more ways in which mechanical aids can be applied to his work than a house carpenter. But a certain amount of training and helpful ingenuity must be offered to almost every man who has suffered the loss of a member, to enable him to get the most out of life that is possible. The number who will require complete training, a total change of vocation, will be small compared with the whole number of wounded, but the number who will have seen a new idea and who will ask for a complete change with the aid and support of the government will be large.

We are only beginning to realize the value of technical or trade training in the country. We are realizing it 10 or 20 years sooner than we would if we had had continued peace. The men in the army rub shoulders with one another as they could not under any other conceivable circumstances. Men who never aspired to anything more than a laboring job have found themselves outranking men whose trained efforts had been paid much more before the war. Sheer ability is a new kind of vocation in which all, or nearly all, have started even, has brought out men in such a way that they will no longer be content to remain in low positions in civil life. They have demonstrated their ability to profit by one kind of training. They will insist on training in civil pursuits in the hope that they can maintain the same relative rank that they have commanded in the army.

We can be almost certain that many men but slightly injured will take advantage of any opportunity which the country may offer them to take up with a better paid vocation, and that they will be entirely amenable to training in a way which the care-free boys who have formerly attended our higher institutions have seldom shown.

TWO GREAT CLASSES OF MEN

There will then probably be two classes of men to be taken care of. One composed of those the seriousness of whose injuries precludes their resuming their old life, and those whose awakened abilities make desire to change. The second group will be composed of those who have been injured in such a way that by learning to use mechanical aids, and studying their jobs in the light of their deficiencies, they can soon go out and earn nearly or quite as much as before.

These classes may not develop immediately on the convalescence of the men. While they are in uniform there will be a sort of hero worship that will prevent any but the most serious minded from doing anything but sit on a throne. After a little of this it will likely change to pity. That will be the dangerous time. If this turns to self pity and to a feeling that they have done all that they should in a lifetime, then we can hope for little progress. If, however, they look upon their insurance money as merely something to help out and realize that there must be some place in the world for everyone, and that whatever job they can do and get paid for will add to that income, it will not be very long before the desire for something more than the barest subsistance will bring them to apply for the opportunity to go to school again. When they do, what will we offer them?

First of all, these men will not lend themselves readily to anything like class work. If we have a thousand men with their left arms missing below the elbow, that thousand will be of every varied type that is known; they will have every shade of ambition, and will want to get into every different vocation there is. Only a very few will require the same treatment. To make matters still more individual there will be other groups of men with different losses and combinations of losses so that we must face the fact that this work, to be effective, will have to be almost entirely individual work. This will force the letting down of barriers. No stated entrance examination, no stated curriculum, no definite period or condition of graduation, but just plain individual treatment, adapted to the needs and probable abilities of each man.

They are not children and cannot be appealed to along the ordinary academic lines. All of them, regardless of actual number years lived, will have been through experiences which will teach them to think straight to the point. They will not be deceived by padded courses.

Schools and Their Faculties

The physical equipment for this rehabilitation is for the most part in existence but in limited amount. Our institutions of learning have the laboratories and the workshops, many of them excellently equipped. If, as is probable, there is a great rush for technical and trade instruction at the close of the war, it will be necessary for them to be run much more efficiently as regards hours and length of term than formerly.

The greatest change, however, will have to be in the attitude of their faculties toward their problem and toward their pupils. Unfortunately the school-teacher attitude has grown to be a set and almost unchangeable thing. It is distinctly paternal and to say the least easy-going. A teacher, in graded schools or in college has a certainty of tenure of office that makes him a protected person. The ups and downs of business hardly affect him at all. His pay check is certain as to amount and time. His relation to his pupils is autocratic. He has something to offer. His pupils may take it or leave it. It does not usually disturb his course.

Under the new order of things all this must change if the work is to be successfully carried out. The teacher must work with and not over his pupils. He must allow them to progress as fast as they are able regardless of whether the class as a whole can follow the pace. He must take care of the man who has to run on low gear, and must see that he is not unduly troubled at the more rapid progress of his fellows. Paternalism cannot be allowed. He must deal with each with even handed justice, handing out instruction as fast, and no faster, than each pupil can profitably absorb it.

It is quite likely that a larger proportion of the pupils can work at abstract problems than is the case with the boys who usually form the classes. These wounded men will come with a distinct object in view, and so long as they see that they are progressing toward that object they will probably be contented to follow the leadership of their instructor. Once they lose confidence in him, however, his teaching days are done. There can be no marking of a few papers and throwing the rest in the waste basket. All will have to be marked and marked carefully and gone over with the pupil. It will take a great deal of work, but it is worth it. It will not be enough to present an idea. It will have to be explained, and if not understood, explained again and again.

This Work Will Be Expensive

This leads up to the statement that successful work of this nature will be expensive for two reasons, one, that it will require many more teachers for the same number of pupils than has formerly been thought necessary, the other, that these teachers will have to be people who can command much higher salaries than have hitherto been paid for work of a similar grade. There is in this a redeeming feature, however, and that is that such men are in the habit of working with shorter vacations, and they will, or should, bring to the work minds better organized for conducting their work with the least brain fag.

The equipment in the best of our schools must be put at work a larger number of hours per day and a larger number of hours per year. The present inefficiency of use of class rooms, laboratories and shops seems to a business man like a lamentable waste. The returned soldier should have the cream of the day time, let the boys who form the regular classes come before and after them. It is only a very small sacrifice for them to make and much better for the good of all than for additional schools to be erected and equipment bought which will in a year or two lie idle. The only equipment necessary which is not easily to be had is that personal equipment, like artificial hands and arms, special holders and other things which the soldier must carry with him from the school. There is no danger or possibility that there will be so many of these men that future employers can afford to furnish them with specially built machinery or appliances. They must learn to use the standard instruments and commercial machines.

The ingenuity of the men themselves can be safely reckoned on. Necessity is still as much the mother of invention as it was when the statement was first made, and these men will feel the necessity very keenly. Their wits have been keenly sharpened to the necessity for taking advantage of every little cover for protection and the use of expedients to which the civilian is a stranger in the repair and protection of their guns and other mechanical instruments of warfare. This has been, more than any other war, a war of mechanism. Thousands and thousands of our men who never before suspected themselves of having mechanical ability have found themselves able to disassemble and reassemble mechanisms which before were absolute puzzles.

Unless the war should be very greatly prolonged, we will probably find that we have the necessary schools, the equipment, and we can find or make the personnel to handle the work. We cannot depend with certainty on the present teachers. So many of them are is such deep ruts that they cannot lift themselves out. We will have to depend on men now engaged in production, who understand what is to be required of these men, and who must be given the necessary training to enable them to present a subject in a clear and understandable way.

The Industrial Restoration Of Disabled Soldiers

By Dr. Bert J. Morris

France, England, Canada and Austria have had agencies working from almost the outbreak of the war to train for and to return crippled soldiers to positions of productiveness in industry. Very shortly we shall have the same task of restoration to do on a large scale. In this article is a review of what other nations have accomplished and an outline of the organizations that are now preparing to reëducate and return our American warriors.

Dr. Bert J. Morris *was educated at Harvard and the University of California and has had an extensive experience in educational administrative work. For the past few years he has carried on investigations in dairying and fruit-growing in California. He is now a member of the staff of the Bureau of Vocational Guidance, Harvard University, and is conducting industrial surveys for the purpose of finding suitable occupations for disabled soldiers and sailors.*

FOLLOWING the example of all the leading nations participating in the war, the United States has taken steps to train and equip disabled soldiers for productive employment. The work appeals to all thoughtful people. In the past the person disabled either in war or in industry has, as a rule, been forced downward in the scale of employment. The result has been to induce economic dependency with the loss of self-respect and personal happiness. It is the aim of the Government to avoid this as much as possible in the case of the men disabled in the present war.

With proper training most of the men returning from overseas can, without doubt, be saved from falling haphazardly into poorly paid and unproductive positions. The drifting of disabled men in large numbers into any field of unskilled employment would, undoubtedly, cause serious economic disturbances. This would not be true, perhaps, under the present labor conditions, but when three or four millions of soldiers are suddenly returned to civil life, and when the other millions of workers who are now engaged in the production of war supplies and munitions are compelled to find employment in ordinary occupations, the situation will be entirely different.

The training of returned men for civil employment must take into consideration the conditions that will obtain at the close of the war. While the war lasts the feeling of patriotism and the demand for labor will make it easy for employment officers to locate disabled men in profitable occupations. The work of placing these men, however, will not be well done unless they are placed so that they will be competent to hold their positions when the feeling of patriotism runs low and the supply of labor is abundant. For this reason the training of men to re-enter civil employment is a matter of supreme importance. No hard and fast standards of training can be established to which men in large numbers can be mechanically adjusted. Adequate work can be done only when individual cases are carefully studied and the men fitted to enter occupations in which their handicaps will count the least. They must be trained and fitted to do the work which they undertake so as to compete with able bodied workmen on a basis of efficiency.

TRAINING FOR WAR CRIPPLES IN FRANCE

A glance at what other nations have done to reëstablish disabled men in civil life will help to a better understanding of our own work. France was one of the first nations to establish trade schools for war cripples. In the early fall of 1914 many maimed and disabled men thronged the streets of her principal cities, while at the same time war munitions plants were suffering because of a shortage of labor. The astute mayor of Lyons, Edouard Herriot, conceived the idea of training the war cripples to enter industrial occupations. On November 30 he obtained the approval of the municipal council of Lyons for his plant to establish a school for the training of disabled men, and within two weeks the doors of what is now known as the *Ecolè Joffre* were opened. Men applied in such numbers that "the old building in the rue Rachais and the sheds built against its garden walls were soon full to overflowing."

To care for the increasing numbers that sought admission, another school was opened at Tourveille on a farm at the outskirts of the city. The buildings here too were old and had to be completely remodeled, but by May, 1915, classes were opened in shoe-making, tailoring, accountancy, book-binding and toy making.

These schools have served as models for scores of other schools that have sprung up throughout France. The courses have been enlarged until at the present time training is offered in the following lines in addition to those mentioned above: Manufacture of artificial limbs, galoche-making, fur work, carpentry and cabinet making, wireless telegraphy, horticulture, and general schooling.

On June 15, 1917, 376 disabled men had finished their training at the Tourveille school. Of the 190 pupils in the school at that time 54 were shoemakers, 16 galoche-makers, 30 tailors, 16 furriers, 11 cabinet makers, 27 workers on artificial limbs, 22 wireless operators, and 14 horticulturists. The number of men who had obtained positions or established themselves in a trade was to that date 129, each of whom was a thoroughly trained workman—master of his trade and well fitted to earn a competent living.

CARING FOR THE WAR-WOUNDED IN ENGLAND

England soon followed France in providing for the training of returned men. The war broke upon the British Government so unexpectedly that it was ill prepared to care for either the dependents of men called into service or for those who might be injured. Fortunately, however, there was a voluntary organization known as the Soldiers' and Sailors' Families Association that had had long experience in looking after the needs of enlisted men. This association rendered very valuable service during and immediately after the African War. Its forces were quickly organized to undertake the work of training and placing men in civil employment.

RETURNED CANADIAN [illegible] STUDYING TELEGRAPHY

CARPENTRY AND CABINET MAKING—TAUGHT FOR THEIR THERAPEUTIC VALUE AS WELL AS FOR TRADE PREPARATION

In February, 1915, the Government appointed a committee to assist the voluntary organization in its work. This committee after a careful study of the situation sent the following report to Parliament:

> We regard it as a duty of the state to see that the disabled man shall be as far as possible restored to health and that assistance shall be forthcoming to enable him to earn his living in the occupation best suited to his circumstances and physical condition.

The committee proposed also that when a man was discharged from military service because of disability he should be entrusted to the care of a central committee acting under the direction of some government department. It was recommended that such a committee should include:

> Representatives of the Admiralty, of the War Office, of the Board of Trade, of the local Government Board, of the Board of Education (in relation to technical training), of the Board of Agriculture and Fisheries, of the National Health Insurance Joint Committee of Employers of Labor, of trade unions or other labor organizations, and of the existing voluntary agencies for obtaining employment for discharged soldiers and sailors.

At the very beginning of its work the central committee recognized that the training of any large number of men for industry involved questions affecting both the employer of labor and the working classes. To place a considerable number of men in any one trade might arouse antagonism and cause industrial disturbances. To avoid such difficulties trade advisory committees have been appointed. These committees are made up of an "equal number of representatives of organizations of employers and work people for special trades that are likely to be affected by the training of disabled men." It is the duty of these committees to advise the Minister of Pensions as to the conditions under which the training of disabled men in various trades can best be given, the most efficient methods of training, the suitable centers for it, and in general to secure uniformity in training throughout the Kingdom.

Trade advisory committees have been appointed for the following trades: printing, furniture and leather goods, boot and shoe manufacture by machinery, handsewn boot and shoe making and repairing, tailoring, cinematograph industry, cane and willow trades, jewelry, brush making, and dental mechanics.

The attitude of the labor party in England toward the training of disabled men has been officially defined by Mr. G. J. Wardle, M.P., and executive chairman for the year 1916. His statement is as follows:

> Subject to there being no diminution in the standard of living or the possibility of a disabled man being used to defeat the legitimate obects which the Trades Unions have in view, the Trades Unions are not only sympathetic but desire to assist the disabled men in every possible way to secure remunerative work.

The placement of the men is looked after with as much care as is the training of them. Of course, in the present industrial conditions due to the war there has been little difficulty in finding profitable occupations. This fact has led many disabled men to take up work before becoming thoroughly trained. Efforts have been made to discourage this on the ground that even the highly trained man with a handicap will find that the stress of economical pressure will be extremely heavy after the war. It can hardly be expected that the patriotic motives which actuate employers today will continue long after the war closes. For this reason disabled men are urged to take advantage of the opportunity to train for skilled work that will assure a definite wage after the war, rather than to become munition workers now with unemployment staring them in the face when the war is over.

PROGRESS IN AUSTRIA

The work in Austria is done entirely by voluntary organization. It was in the summer of 1915 that Dr. Sudek, Director of the Official National Employment Bureau for War Invalids in Vienna, conceived the idea that the most effective work on the behalf of disabled men could be done by organizing under one head all the activities of the various humanitarian societies and private individuals who were interested in finding work for war cripples.

The work of organizing these societies in Vienna was completed in July, 1915. Immediately following the beginning of the work there, similar bureaus were formed in Prague, Brünn, Troppau, Salzburg, and Linz. The first work of the bureau was to ask employers to state what openings they could offer that would be suitable for handicapped men. The response was so generous it was startling. Within three months after the bureau was opened Dr. Sudek states that about 10,000 jobs were opened to returned men.

The fact that a number of jobs were offered did not make it easy, however, to locate the men. The officers found that it was difficult to fit the man to the job. This fact led the bureau to make a special study of each individual case so as to be able to give valuable vocational advice. In cases where the bureau is unable to decide on any suitable course it confers with technical and medical experts furnished by a special commission composed of experienced physicians and social economists. If the applicant refuses to accept the advice of this commission of experts he is not compelled to take up training but does forfeit any further claim to financial assistance from the bureau.

INSTRUCTION IN OXYACETYLENE WELDING
A Suitable Trade for Returned Men in Which There is a Constant Demand for Skilled Operators.

How Canada Provides for Her Returned Men

In Canada the work of re-establishing disabled soldiers in civil life is under the direct control of the Government. For this specific purpose a new Cabinet ministry has been created entitled the Department of Soldiers' Civil Re-Establishment. The minister is Sir James Lougheed who is carrying on the work through two branches, the Board of Pension Commissioners, and the Invalided Soldiers' Commission, formerly known as the Military Hospitals Commission. The latter branch has charge of the work of re-educating the returned men and placing them in remunerative occupations. It was organized by the Military Hospitals Commission in June, 1915, under the direction of Mr. T. B. Kidner, Vocational Secretary for the Dominion.

At the head of the Invalided Soldiers' Commission is Mr. Segsworth. Under his office at Ottawa there are 30 district offices, each in charge of a district vocational officer who is responsible for all the work carried on in his military district. These districts usually correspond in area to that of a province. An exception has been made in the case of Ontario where there are three military districts, each with a district officer working under the vocational director in charge of the whole province. In addition to the district vocational officers, there are vocational inspectors who travel about through all the provinces and report to Mr. Segsworth at the head office in Ottawa upon what is being done in the various districts.

At the very outset industrial surveys of various sections of Canada were undertaken for the purpose of ascertaining the greatest possible number of opportunities for the training of disabled men. In order to overcome the possibility of men competing against each other in a certain narrow group of occupations the commission decided to re-educate as many of them as possible in shops and factories where they would subsequently be employed. More than 175 different occupations have been found for which men are being trained.

One of the problems which the committee had to face arose out of the fact that many of the men are between 30 and 40 years of age. As a rule men at this age make better progress by beginning at once in a shop rather than by taking a course in a trade school. Usually they are unwilling to try new work, so it has seemed advisable to train them as far as possible in the work which very closely resembles what they were doing before entering the war.

CLASS FOR DISABLED SOLDIERS IN ELECTRIC WIRING

For younger men trade schools and universities having departments for technical education have been used with splendid results. Provincial institutions such as normal schools, colleges, and agricultural schools are very widely used. In many cases the men take a thorough course which prepares them for definite occupations. In other cases men are placed in shops where they take up a special line of work under the direction of an industrial vocational officer. The work in the shop is usually supplemented by instruction in part-time or evening schools. The previous experience of the man as well as his educational training determines the method in his re-education. Each man is carefully interviewed before being placed in training and is dealt with according to the merits of his case without regard to precedent.

The Canadian system has been meeting with splendid success. Up to June 1, 1918, nearly 5,000 men had applied for training, while about 500 of these had completed their courses and found remunerative employment.

The prevalent idea seems to be that most of the disabilities of soldiers are amputation cases. The fallacy of this idea is clearly exposed by the following classification of 1300 cases of returned Canadian soldiers.

Classification According to Disabilities

	No. of cases	
1. Leg disabilities:		
Amputation of right leg	11	
Amputation of left leg	7	
Limitation of movement	180	
Varicose veins	21	
Total		219
2. Lungs and pleura		172
3. Arms:		
Amputation of right arm	7	
Amputation of left arm	7	
Limitation of movement	136	
Total		150
4. Feet:		
Amputation of right foot	2	
Limitation of movement	62	
Flat feet	21	
Total		85
5. Heart		71
6. Rheumatism		73
7. Abdominal and pelvic injuries		64
8. Hands:		
Amputation of both hands	1	
Amputation of left hand	2	
Amputation one to four fingers	15	
Limitation, control left hand	17	
Limitation, control right hand	25	
Total		60

9. Defective vision:		
Totally blind	3	
Serious defect	41	
Total		44
10. Hearing		40
11. Neurasthenia		36
12. Kidneys		34
13. Shell shock		31
14. Fracture of skull		23
15. Spinal injury		20
16. Gassed		18
17. Miscellaneous cases		160
		1300

Plans for Rehabilitation in the United States

The United States is making as thorough preparation to refit disabled soldiers for civil employment as it is to win the war. On June 27, an Act of Congress was approved which places a sum of $2,000,000 in the hands of the Federal Board for Vocational Education to provide for the training and placement of disabled men in remunerative occupations. In order to profit as much as possible from the experience of the Allied nations, the Federal Board made a careful study of the work being done by those nations. Canada was selected for especial study. In coöperation with the Red Cross Institute for Crippled and Disabled Men of New York City and other Federal boards, the Board for Vocational Education sent a party of carefully selected educators to Canada for a three weeks' study of the Canadian work. In addition to this the Federal Board has brought to Washington as the Board's chief advisor, Mr. T. B. Kidner, Dominion Vocational Secretary, under whose direction the vocational work in Canada was organized. Dr. James C. Miller, formerly district vocational officer for the province of Alberta, has been appointed supervisor of the establishment and operation of district vocational offices.

The Federal Board proposes to establish at least fourteen regional offices at convenient centers throughout the country. As yet few disabled men have come back from overseas, though there are a considerable number of men in reconstruction hospitals who have received injuries during training at cantonments. These men will be placed in training under the supervision of the regional offices as fast as their applications are approved by the Board.

It is not anticipated that it will be necessary to establish many new institutions for the re-education of the disabled men, as it is the intention of the Board to use the facilities of existing educational institutions as much as possible. Individual cases will present different problems, and the Board is considering the establishment of a few small experimental schools in order to test out the vocational possibilities of men with various handicaps.

On June 27 a conference of principals representing the largest private commercial schools east of Chicago was held in Washington. The purpose of the meeting was to discuss plans for giving commercial courses through such schools to returned men who may desire this kind of training. As a result of the conference training in commercial lines will, in all probability, be provided through carefully selected business schools under the supervision of representatives of the Federal Board.

Whether given in existing institutions or in newly established schools, the education proposed will, according to the announced policy of the Board, be for the most part in "highly specialized occupations, which are good paying, manly callings which have a definite, useful place in the business world. The idea is to turn out thoroughly trained men for men's jobs at men's pay, despite the physical handicap which may have rendered the men useless in their former callings."

In speaking of what trades should be taught disabled men, Dr. C. A. Prosser, Director of the Federal Board, made the following statement:

> The first requirement is that they be trades in which the local employment possibilities are good and in which there is a definite demand for a greater number of skilled operatives; that they be not seasonal trades; that they be growing rather than on the wane; and that the wage standard be satisfactory.

In the United States as in Canada we will be forced to deal with men having the greatest diversity of interests, experience, training, ambition, and ability, as well as with men of varying ages. The problem of continued education for those still in college or high school at the time of enlistment, and the kind of assistance to be offered for clerical, business, professional, and technical pursuits are questions relatively easy to answer. Our gravest difficulty will arise in connection with the very large industrial group who either have no skill in any trade or occupation, or are so crippled as to make it necessary to prepare for some new form of employment. The very great demand for men to fill minor executive positions, for foremen and inspectors, and for men with various kinds of technical preparation less than that offered in our colleges points the way for many of the cases where a skilled man must seek some new task because of his handicap. Only by local investigations such as are being made in Canada and by careful study of each case, can these adjustments be made satisfactorily.

As indicated above, the plans of the Federal Board for Vocational Education provide for a division of the country into districts, each section to be under the supervision of a district vocational officer who will have charge of vocational advice and training as well as of finding employment for the men placed under his care. No adequate appropriation has been made by Congress for carrying on surveys of this kind that will be necessary in inaugurating this service. Organizations similar to the Harvard Bureau of Vocational Guidance are assisting the Federal Board in collecting these data.

Work of the Harvard Bureau

The Harvard Bureau is just beginning a state-wide survey of opportunities for training and placing disabled men in Massachusetts, and has just completed a survey of the coppersmithing trade which is to be published at once by the Red Cross Institute for Crippled and Disabled Men. Other investigations are under way and additional reports may be expected shortly.

Employment managers can be of great assistance in this work in various ways. They ought first of all to coöperate with the local agents of the Federal Board who are carrying on surveys, planning training courses, or preparing for the work of placement. Several large companies have made very careful studies of the opportunities for placing disabled men in their own plants. The information collected will also be of service in planning for training returned men.

The Hood Rubber Company of Watertown, Mass., keeps a record of the United States post office addresses of all men who leave their plant for military service and will endeavor to place them when they return. A very complete job specification study has been made by an employee of the service department in order to list the more important opportunities for placing handicapped men. A Girl's War Relief Club has been organized to assist enlisted employees in every possible way. This organization, as well as the service department, will endeavor to keep in touch with the men during their absence.

The attitude of the American Federation of Labor toward the vocational rehabilitation of disabled soldiers was clearly defined by the executive council's report to the annual convention June 10, 1918. The report contains the following statement:

> The American Federation of Labor is particularly interested in the re-education and re-entry of disabled soldiers and sailors into industry. The members of our organization will have an opportunity to perform an invaluable service to society in coöperating with the Federal Board for Vocational Education in carrying on its work. . . . The duty of the hour requires that all classes of citizens, whether they be employers or employees, give a full measure of support and active coöperation in administering a law which has for its purpose the making of disabled soldiers and sailors productive members of society.

A soldier at the front in writing home to a Boston newspaper relates the following incident: "One of the boys on the way back after a raid got caught in a counter-barrage. His leg was taken off at the knee. He did not whimper, and as he fell his first words were 'Well, I hope the lead pencil business is good in Boston.' "

The spirit thus manifested is truly wonderful, and if anything more was needed, this should be sufficient to awaken interest in the rehabilitation of all disabled men to the end that not one of them shall be obliged to sell shoe-strings or lead pencils on the street, but that each one shall be, as far as possible, suitably equipped for participation in the normal activities of civil life after his return.

* * * *

Supervising a Large Tool Department

A Step Toward Greater Economy in Tool Development

By C. W. Starker

Economy is the watchword in industry today. In every large manufacturing organization the tool department has grown to large proportions and the tools have become more and more involved. In this article Mr. Starker *gives from personal experience a description of methods developed in the tool department to coördinate requirements and to minimize tool expense. By an analytical study of all questions relating to tools before proceeding with their manufacture great savings are accomplished, if the tool supervisor is equipped with the necessary experience and personal characteristics.*

Mr. C. W. Starker *has been a member of the engineering staff of one of the largest industrial corporations in this country for many years. He has originated improvements in design and manufacture of electrical apparatus and has developed comprehensive systems of cost analysis for manufacturing purposes. His name and papers are familiar to our readers.*

EVEN in the old days of the small individualistic shop the tool room was considered an important element, the star department, although at that time most of the men made their own tools and these were limited to drills, taps, lathe and planer tools and the like. With the increase in size of manufacturing organizations the plan of interchangeable production was introduced. This required jigs and fixtures for doing the work, gages for controlling accuracy and uniformity, milling cutters for repetitive work and a variety of small tools for the new special machines which came into use. All of this tended to increase the importance of the tool room, from it radiated all the larger things; manufacturing methods, production schedules, wage systems, everything in the manufacturing departments came to depend on the small tool, insignificant pieces of steel worked into many different shapes to turn, bore, mill or shape.

Hand-forged parts gradually were superseded by drop forgings; stamped, pressed or drawn steel parts largely replaced hand formed or cast parts due to their greater economy in quantity production and other advantages. All of these improvements meant tools for manufacturing, and dies, often of a complicated nature, were required. While the new methods permitted the use of less skilled, cheaper labor in actual production as, for instance, in feeding a punch press compared with hand forming operations, the demand upon the skill of the tool designer and the mechanic in the tool department multiplied. As indicative of this trend there might further be cited the increasing use of die castings and parts press-molded from insulating compositions, all requiring more or less complex steel molds. So the "tool room" as we are still in the habit of calling it, grew into a tool manufacturing department, employing in large organizations up to 1500 or more men. The designing of large tools such as are required for heavy press work requires trained and specialized designers and in many cases involves as much or more engineering thought than the designing of the part that is to be manufactured.

The closer study of machining operations, cutting speeds and feeds resulted, on the one hand, in standardized tools of scientifically determined shapes manufactured in a centralized department, instead of the tool made by the individual workman according to empirical theories of his own. On the other hand there followed the introduction of a variety of alloy steels each adapted to certain definite purposes. With these came the scientific application of heat treatments and hardening processes in place of the rule-of-thumb methods previously in vogue. The number of drawing operations and annealings necessary in drawn work, which determine the number of dies to be made for a given article, are now fixed, not exclusively by experience, but with the aid of microphotographs showing the changes in the structure of the material due to forming operations.

Efficiency of Productive Operations Depends On Tools

This partial outline of the scope of tool-room activities is given in order to show the increasing importance of that phase of manufacturing and to bring home the fact that improvements in the organization of the department have not kept step with the demand, so rapid have been the change and growth. All our products are becoming more involved and complex, not simpler and cruder, and so call for higher skill and training especially in the tool room. The manufacture of ammunition, rifles and other war material has taught the lesson of how much manufacture depends on the tool room. The efficiency of the tool room is a direct measure of the efficiency of the entire manufacturing organization; old-fashioned tools mean old-fashioned methods of production and wage systems; failure to live up to schedules in producing workable tools upsets production schedules and deliveries throughout the works. Advanced work on the other hand, based on the latest results of the research laboratory and guided by trained mechanical engineers secures to the organization an advanced position.

Supervision of Tool Department

In the following paragraphs the work of a general supervisor of tools is outlined from the writer's own experience. It is evident that under the new conditions several things must be done. The practical knowledge of tool making handed down by word of mouth and accumulated in many years of experience by the executives of the tool department, superintendent and foremen, must be crystallized and made generally accessible. Their practical experience must be supplemented by the knowledge of the mechanical engineer, the research work of the metallurgist and the expert in machine-tool operation. On the other hand, the engineer or draftsman, who in designing a new piece of apparatus must consider manufacturing requirements, and for whom in the past a general knowledge of pattern work and foundry methods was sufficient, must now have his knowledge supplemented by tool experts, if he is to design new apparatus with a minimum of tool cost and for the best manufacturing conditions.

The correlating of these different activities is the principal function of the supervisor of tool development. The tool-room executives, busy with matters of distribution of work on the floor, employment, equipment, expense control, production schedules and similar matters lack the time to do justice to this side of the work and cannot possibly be familiar enough with the problems of the designing engineer to direct designs into more economical channels from a tooling-up standpoint.

Procedure in Tool Development

To understand the supervisor's function it is necessary to review the procedure which, with modifications in details, is followed by all large manufacturing organizations in authorizing tool development. Let us assume that a committee, composed of members from the sales, engineering and works departments, has favorably reported to the management the desirability of developing certain new apparatus and that this report, giving in a general way an estimate of the expenses entailed, sales possibilities and so on, has been approved. The first step is then to design one or more of the various sizes of the apparatus proposed, build them experimentally and subject them to thorough tests. These samples should be, and usually are, built in a separate experimental department where they are made by hand, or with merely the most necessary hand tools by first-class mechanics. After the successful operation of the devices has been established and changes made by the engineering department to improve performance as well as to cheapen manufacture by the tool method, the final drawings are sent to the superintendent of the department which eventually is to manufacture the article with a request for tool estimates.

This assembling section considers their requirements from the standpoint of their equipment—kinds of machine tools available—and then transmits to the tool department a list of the tools needed, including those required by the various feeder sections doing part of the work. Upon receipt of these requests the work of the supervisor of tools begins. He studies the design and tool request in coöperation with the tool estimating section, the chief tool designer and the superintendent of the tool department. If necessary conferences are arranged with the designing engineer or sales representatives in which various points are discussed regarding the justification of tools, quantities required to be manufactured, etc., and suggestions made for alterations in the design with a view to facilitating manufacture, reducing tool cost or tool maintenance expense, etc.

Tools Warranted By Activity

The first question that will be asked in such an analysis of tool problem is, What is the activity of the apparatus and the probable life of the design? This point at times is not fully appreciated by the engineer designing the apparatus. Tools may be made not only to build the article but to manufacture it in large quantities. They may be made practically without reference to first cost, merely for obtaining a minimum cost of product. The article may be a novelty that will sell in large quantities but dies out quickly, as, for example, certain parts for automobiles where the style changes almost from year to year. The tools, therefore, should in this instance, be so constructed that with low tool cost large quantities for a short period can be manufactured. The cheaper carbon steels will find their use here for punches, dies and forming tools, and machine steel for milling cutters, with no expense incurred which is not absolutely necessary. In another class come tools for articles where the demand may be limited but permanent, that is, an apparatus or design that is reasonably certain to hold the field for a long period of time, so that life, possibility of repair and maintenance expense of the tool become prime considerations. It is apparent that in this respect considerable judgment is required, and the ability of deciding between diverging opinions is essential, for the sales representatives are by nature optimistic, and the works representatives are apt to be skeptical

It is unnecessary to show forms and blanks for tool estimates here, they may be made up in different ways, but one of the essential things is that the activity of the article and the probable life of the design be stated, and these data must be determined by thorough consideration on the basis of sales and engineering records. The expense involved in tools is so great and the amount squandered by careless methods so detrimental, that tool estimates or tool orders should always be signed by a superintendent or general foreman, not by a clerk in the production office.

However, there is almost as much likelihood of insufficient tooling-up as there is of extravagance in tool requests. Means should be provided to have the activity data corrected if the demand changes. In manufacture it happens sometimes that production is greatly hampered, schedules upset and criticism incurred due to the fact that activity has increased beyond the estimate, which may have been made up conscientiously and conservatively, but not revised when the greater demand came. If the requirements increase materially, duplicate tools or tools adapted for greater quantity production should be provided, different types of punch presses may, for example, be used or several operations performed at one time with correspondingly greater tool cost, or higher grade steels may be used, so that the tools will stand up longer before requiring regrinding and repair.

In the case of old tools, that have become worn out, the question of activity should not, as often happens, be lost sight of in renewing the tool, but should be given equal consideration with new tools. It may be that a costly die or other tool was fully warranted in the earlier period of the life of the design, but that, after this tool has been worn out, the probable balance of the life of the design is short and only a simple tool should be made, even if this involves a somewhat greater cost of production, rather than replacing the old tool by an exact duplicate, as is often done in a routine way. Renewed tools should incorporate all the improvements which experience may teach, in the design and working of the tool, as well as in improving performance or cheapening production of the article itself. With this in view a system has been provided whereby both the manufacturing section and the designing engineer are consulted before any renewal of tools is authorized by the supervisor.

Importance of Tool Records

The second question the supervisor will ask himself in analyzing a design presented for tool estimate is, Can any of the existing tools be used or adapted? In a large manufacturing organization enormous amounts of various tools, dies, formers, benders and the like are accumulated and the records of such tools are frequently entirely inadequate. One or two clerks are usually detailed for keeping books, in which the various tools are listed. From their daily work they acquire, as a rule, considerable experience as to what tools are available, but these records should be general property, not one man's stock in trade. This is the case particularly because the clerk does not always have the knowledge or judgment to say what tool might be used or, putting it in another way, around what existing tools a new design might be worked out. Some time ago in organizing a department for supervising tool development in a large manufacturing organization one of the first steps taken was to have better and more accessible tool records made up. The particular form used is immaterial, whether on cards or in book form, but copies should be available not only to the tool department, but in the various engineering and drawing offices for reference in laying out the first design of new apparatus. These records showed not only the final shape of the piece but the various steps in its production, as for instance draws in the case of drawn parts, cup shapes, etc. It is often quite possible to use existing tools for certain intermediate operations, adding, perhaps, a hand tool for a final operation to produce the desired shape of the design. Very surprising savings have been produced by close attention to this point of using existing tools. It requires in the supervisor of tool development a designing ability and a certain inventiveness or resourcefulness to see the designing engineers' problem and to point out the possible use of existing tools in each instance. Tact in making such suggestions and enough authority to carry sufficient weight to have the suggestions accepted are very desirable adjuncts in this work.

Value of Sample Boards

With a few of the leading companies specializing on pressed, punched or drawn metal work, it is customary to provide sample boards or sample rooms, where a specimen is kept of all the more interesting pieces made by the tools. There is usually one sample for each operation, where several operations are required. The writer has used and expanded this idea with good success. These sample boards are inexpensive, the parts being simply hung-up on horizontal rods if small, or laid out upon tables if large. The sample can be used by the inspector as a prototype and parts made from worn dies can be checked up with the first specimen from time to time. The sample boards stimulate the justifiable pride of those who produce the work. Pride in accomplishment, enthusiasm for the work, should always be considered a very desirable element in a manufacturing organization particularly in the present days when the stimulation of mere quantity production by premiums and bonuses has done so much to lower the skill and workmanship of the mechanic.

Third, the samples are an excellent educating medium for tool designers and tool makers, as well as for the designing engineer and draftsman. Frequently designers have been taken to these boards and in a few minutes by visual demonstration have been given a better idea of the action of material in dies, of possible depth of draws, influence of flanges or corners on drawn or bent parts and so on, than could have been presented in any other way. Then too, the exhibition of samples that have given a great deal of trouble, either in the making of the tools or the production of the article, serve as a warning, an object lesson to all. These failures are perhaps more instructive than the good examples, for we learn more from our mistakes than from our successes. If these samples were not shown to the younger men coming up in the organization, it is more than likely that they would have to go through the same experience, at the expense of the company, and to the detriment of the industry as a whole.

Tool Data for the Designer

However to get at the root of the evil, if such it may be called, that designs that are impractical from a tool standpoint or, at least, not the best possible, it is necessary to go back to the source, that is, to the designing engineer and draftsman where the designs of parts originate. Designing data as definite as possible should be made available for his guidance in designing parts which require dies and other tools, in addition to consultations with the tool department and occasional visits to the sample board. The tool record referred to above should contain not only forming or piercing dies, benders and the like, but should include milling cutters, drill jigs, building fixtures and so on, for frequently the design of a new part of an apparatus, usually a modification of something similarly designed before, is unnecessarily made so as to require a new set of milling cutters which may cost several hundred dollars, or so that it is impossible to use or adapt some jig or fixture already made and in usable condition.

Designing draftsmen and engineers should have a good general idea of the construction of the tools they are principally concerned with and the action of stock under the press. Instruction sheets giving typical cases of die construction and standard practice sheets along the lines referred to have been used to good advantage. The designer should be informed under what condition, for instance, the inherent advantages of punched parts, notably low cost of labor, accuracy, etc., are realized, that stampings are essentially a quantity proposition so that he will resort to these forms in the proper places. The relative costs of different kinds of tools, together with their respective costs of product, plotted in the form of curves, are used to indicate when the one or other should be considered.

Written standard practice instructions are one of the twelve fundamental efficiency principles, and it is entirely wrong to ridicule efforts in this direction as an attempt to substitute an instruction book for the skill and experience of the designer. It is true, however, that it is difficult to give positive data when it comes to issuing definite rules for designers in regard to such matter as possible depth of draw for different thicknesses and kinds of materials, steels, copper, aluminum, for there are many factors entering into the question, as the rounding of corners, clearance between punch and die, draft, type of press used, etc. But after a start is once made, fairly definite rules gradually work themselves out and are found to be of great benefit in the work. The limiting size of hole which may be punched in a given thickness of material is difficult to give in a general statement. Usually the rough rule is made that the diameter of the hole should not be less than the thickness of the stock. This may be taken as a general rule, better than no guide at all, even though we might be shown that someone has successfully punched holes in material, the thickness of which greatly exceeded the diameter of the hole, by providing special stiffening supports for the punches or by other means.

Tool Estimating

We have followed the steps leading up to the development of new tools to the point where requests for tool estimates were sent to the supervisor of tools and analyzed by him in coöperation with the tool records section, the chief tool designer and the superintendent of the tool department. Having checked up the design of the parts, and after the changes, if any, have been made, estimates of the tool cost are prepared by the estimating section of the supervisor's office. There is the fundamental rule that such estimating means, not guessing, but a detailed calculation of the hours of labor in machining, hours of labor in assembling and fitting, at such and such rates of wages, burden chargeable to the work, amount of material of various kinds required in pounds and dollars, including also a reasonable amount of experimental work in connection with the making and trying-out of the tool. It is very essential that these estimates be made as accurately as possible, and in all cases, except for the simplest tool, the design should be laid out on the drawing board before estimating.

As a necessary working basis, records of actual costs of similar tools should be available for ready reference, and they should be arranged in such a way that changes in labor rates or material prices can readily be taken into account see ("How to Make and Use Barometric Costs," Industrial Management, August, 1918). The giving of the hours of actual work, including allowance for doing-over part of the work, is essential, so that the production department may base its delivery promise for tools on that time, taking, of course, into account the amount of work on hand when the order for the tools is received by the tool department. Owing to experiments, alterations and the possibility of accidents in hardening, it is frequently difficult enough for the tool department to adhere to definite production schedules. On the other hand, a failure to meet promises for the completion of tools would be felt in all manufacturing departments and is likely to upset production schedules and delivery promises.

If overtime is resorted to in making up for lost time, the tool cost is likely to exceed the estimate and controversies result, unless a revision of the estimate is made and approved beforehand. The estimator must be fully familiar with machining operations and must work in close coöperation with the rate-setting department. Underestimating of the tool cost may result in loss of profits from sales, overestimating by inaccurate or overcautious figuring is equally undesirable, as it may result in the loss of business to the company. All estimated costs should be checked up against the actual cost, after the latter has been compiled upon completion of the tool. The form filled out as an estimate should state specifically, how the tool was intended to be made, particularly in case no drawing is available, and what existing parts of tools, if any, the estimator figured upon using. Otherwise a discrepancy between the estimated and actual costs will lead to controversies.

If estimates are chronically exceeded, it is well to see whether the excess is due to remaking tools due to errors, to wrong charging methods, to an incomplete estimate or to alterations in the design of the part while the manufacture of the tool was in progress. A graphic record of excess of tool estimates in percentage has been found to lead to a gradual adjustment of the basis of estimating, and eventually estimates, accurate within a few per cent. are obtained even in difficult cases where no precedent to be followed was at hand.

Approval of Estimates

According to usual practice the story should now go on to say that after the estimates are made, they are approved by the management and the manufacture of the tool proceeded with. This procedure is wrong for two reasons. What more can an approval by the management, that is, a very busy works' manager or vice president, be than a general control of expenses and systems of handling work? The actual check, whether this tool or that in a long list may be omitted or whether its cost is right and justified, must be made before the estimates receive a more or less perfunctory O.K. Further, it is only logical that the party ordering something to be done or requesting an estimate should be given a chance to say whether he is satisfied with the cost as estimated, before proceeding with the order.

In our case the designing engineer has, in designing the new apparatus knowingly assumed certain new tools to be required and the manufacturing superintendent desires certain tools to be made, but it is often quite a rude awakening to both of them to compare the carefully estimated costs of tools with what they thought they would cost when asking for them. There has been more than one instance in the writer's experience, where, upon reviewing the estimates, the engineer or manufacturing superintendent revised his requests. Therefore, after an estimate is completed it should be reviewed by the parties requesting it, or whoever is most vitally interested in it, before final authorization is given. Then only, that is after changes brought about by this check have been made, should the tools be actually ordered. This is done on suitable forms which either refer to the estimate as a basis or otherwise limit the amount authorized. Account number, date for and place of delivery for the tool, and existing tools, which may in part be used, should be stated on the blank by the proper persons in the planning or production departments.

TOOLS MADE ON A MANUFACTURING BASIS

It is not intended in this article to enter into the design of tools, although supervision of this feature is part of the supervisor's functions, but it will be of interest to discuss briefly a few of the other points which come up in connection with tool development. Frequently the cost of tools as shown in estimates, is criticized in a general way as being excessive. We may ignore critics not familiar with how the tools are constructed or what operations are involved, but the same statement may be made by those qualified to judge. The first step toward reducing manufacturing costs of tools is standardization and quantity production. All tools which are made time and again, perhaps with slight modifications, should be of a uniform, standardized design in all details. Van Dyke prints of the different standard tools, to be filled-in as required, reduce drafting expense. Production on a manufacturing scale with piece or premium rates set as in other work, can be followed for all such parts as die shoes, punch holders and many of the detail parts. The use of expensive steels should be resorted to sparingly and the saving carried to the point of, for instance, providing different standards for the length of punches depending on the material to be punched, having shorter punches for copper or where long life and frequent regrinding are not required.

THE FINISHING OF TOOLS

In many of our tool rooms there is still too much hand work done in place of machine methods, and special machines such as profilers are frequently warranted. The fine finishing and polishing of parts, which tool makers invariably like to do, must be limited. On the other hand, it is the writer's experience that this extra touching up (usually the first thing criticized by the casual observer) does not add as much as is often assumed to the cost, and it may be the part of wisdom to consider the feelings of the tool maker, whose ambition it is to turn out work of good appearance. That spirit, rare enough at the present time, should not shortsightedly be destroyed.

THE "COBBLER SHOP"

In a small shop different degrees of care and refinement in executing a customer's order are easily followed; everyone knows who the apparatus is for, how many are to be made and what parts must be accurate or where a little sloppy work does not matter. In this way all that is necessary may be done, and no more expense incurred than the individual case warrants. The large organization loses this advantage, it is difficult to have two standards of quality. This means, that everything must be made for the most exacting case normally occurring, and that method naturally entails quite a bit of wasted effort and expense.

In the tool department it is possible to give to a large organization that advantage, by establishing a section for "small quantity tools" or temporary tools. That is, for tools made in the simplest possible way to fill an order on hand for a few hundred pieces. It has been found best to separate this work —which tool makers at first are inclined to look down upon as patch work and dub the section the "cobbler shop"—from the main tool department, as otherwise a general lowering of the standard of workmanship might easily creep in. Not that these temporary tools do not produce perfect work for at least the quantity in order, but the general methods followed should not influence the manufacture of standard tools. Very surprising results in dollars and cents have been demonstrated by this temporary tool method. In one case, for instance, regular manufacturing tools were estimated at $1200 for a small article selling for a few dollars a piece complete. The order called for 1000 pieces and repeat orders were doubtful. It was possible, in part by using existing tools, in part by adapting hand tools made originally to produce the experimental sample, to complete the entire order at an actual tool cost of less than $100. Had the tools been made as first estimated, the profits from sales would have been nil.

Inasmuch as temporary tools are not very desirable in a punch shop or similar department under a regular manufacturing plan, the question may arise, Is it not better to let the temporary tool room take care of the small orders for parts? A compromise in this respect has been found best. So long as there are only a few such cases to be handled there is not much hardship imposed upon the tool room in filling the order while the dies are set up for trying out. On the other hand, the tool room should not be made a manufacturing section and the plan suggested should not be carried to extremes.

TOOL DRAWINGS

It has already been stated that drawings should be made for all tools. As another step in keeping down tool cost it is necessary to get the men to work from the drawings. In any other department it would seem strange to make a special point of this self-evident matter, but in the tool room the men are still too much inclined to work by the cut-and-try method, or at best from sketches of their own or of the foreman. There are two things to keep in mind in this connection. The foreman who spends his time in making sketches neglects his other work and his principal functions. And changes are more easily made on paper with the eraser than in and with pieces of tool steel. Just one example to show how these simple facts are forgotten: In the writer's experience large forming dies for rather heavy pressed work, weighing several thousand pounds, were made some years ago without first preparing drawings and thinking out carefully every point on paper. The results was innumerable changes on the castings or forgings. Finally there resulted a set of patched up tools and much argument why they cost so much. Therefore, complete drawings of all tools should be made (filled-in prints will sometimes do) and these drawings should be followed by the men.

INSPECTION OF TOOLS

During the manufacture of tools the parts should be carefully inspected There is no reason why the tool department has in the past been excepted from this generally accepted shop rule. This inspection should include a check of the principal points of the part made with the tool. To this end gages should be made simultaneously with the tool and included in the tool estimate to start with. Before the tool department delivers a tool a try-out should be made as a final check. It is necessary therefore to equip the tool department with facilities for such trials.

COMBINATION TOOLS

When several sizes of an article similar in construction are to be made with tools, it is frequently possible to construct the dies so that succeeding sizes can be taken care of at relatively small tool cost, if taken into account from the start.

There are cases where the tool cost can be reduced by combining several operations into one, such as blanking and bending, or drawing and piercing operations. On the other hand, attempts to have several operations performed in the same die, may at times be less economical than several simple and straightforward tools. A general rule in this respect cannot be given, but from the writer's experience, there is a tendency to overrate the advantage of fewer operations. After all, each operation may amount to only a fraction of a cent in the cost of product, when we consider that presses make 75 to 90 strokes, that is, pieces, every minute.

Tool Costs Out of Proportion to Saving

Tools are not always made in order to cheapen production. Drill jigs and fixtures, for instance, are needed merely to produce interchangeable parts. But as a rule the lower cost of production is the direct object, and the calculated saving should, therefore, be greater than the tool expense. It is well to state on the tool order the estimated saving by the use of the tool, together with the quantity, so that the tool cost may be balanced against the total saving. In this connection it is desirable that a thorough understanding be had between the manufacturing section which is to use the tool and the tool department, as to what is or can be expected of the tool in the way of accuracy, life, regrinding time, and so on, in order to avoid controversies later on.

Some times tools are ordered by a manufacturing section which, in the judgment of the supervisor, should be purchased from outside concerns who make a specialty of the work and are better equipped for it. This consideration applies equally to the tools themselves as well as to parts made with the tools. The question is readily decided when the tool department on account of pressure of work is unable to produce the tools, but ordinarily a decision must be carefully based on the relative prices and the permanency of the demand. If permanent, the desirability of equipping for the work must be studied.

* * * * *

Without going into that part of the work of a general supervisor of tools, which concerns his share in tool design, in standardizing of tools and methods, or in research work on materials and processes, I have dwelt particularly on his duties in connection with the development of new tools, as being the most important part. Here his principal functions are to systematize methods of handling the preliminary work, to form the link between works and engineering and to coördinate different ideas, all with a view to safeguarding against avoidable expense, by whatever methods may be demanded in the individual case. I have shown both that the work is important enough from the standpoint of management and the field broad enough to attract the best talent among mechanical engineers.

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A Tested Profit Sharing Plan

An Average of Forty-Six Per Cent of the Company's Profits Are Distributed to the Employees

By Dale Wolf

The two factors that determine the percentage of profits paid to each worker of the Miller Lock Company are: Production during the month, and the length of service of the employee. The plan has been successfully in operation for a number of years and its details and advantages are fully presented herewith.

Mr. Dale Wolf *was trained in daily newspaper journalism and had some four years' business experience in the Middle West. For nearly three years he was Industrial Betterment Extension Secretary of the Central Y. M. C. A. of the City of Philadelphia, specializing on employment and labor maintenance problems. He is now Director of Employment of the Miller Lock Company, Philadelphia, Pa.*

WALKING home a few evenings ago with the foreman and the assistant foreman of the tool room the topic of conservation turned from the war to the subject of our profit distribution which was to take place the following day.

"I'll tell you what I did with my profits last month," said the foreman. "I bought both of my boys new shoes, bought myself a new cap and shirt and gave the rest to my wife to buy her some little things for herself. Now to-morrow I won't get quite as much as I did last month and I have promised to give it all to my wife to buy something that she needs."

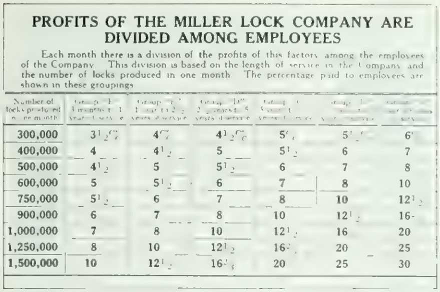
Then the assistant foreman and myself told what we were going to do with our share in the company's profits that we were to get on the morrow. Each of us had something in view to purchase with our dividends instead of sticking the dividends in the bank as would many stockholders.

The Probationary Period

The attitude cultivated in the Miller Lock Company, is that every employee is a stockholder in the company after probation. This period of probation is a testing time for both the company and the employee.

When a person is employed the firm promises certain wages in the way of guaranteed day work rates, and in addition tells of the possibilities of increased earnings in the weekly pay envelope by an increase in production. Other things are promised in the way of factory conditions, rest periods, sanitation, eating facilities, medical care, working hours, pay for overtime, etc., all of which makes the employee decide that he "will take a chance."

Of course, the employment department of any plant will paint a picture of the future and what it offers to the prospective employee, but so few of the average run of industrial workers can see very far into the future. (If they could have looked into the future they probably would not be applicants for work). Most applicants for work think only of the present and what a man will be able to make the first day. During his interview with the employment director he determines

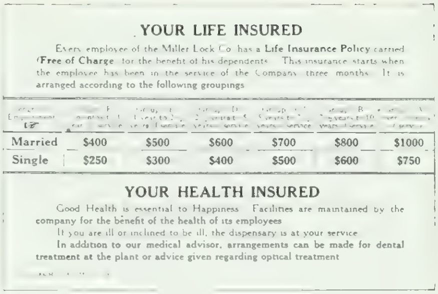


PROFITS OF THE MILLER LOCK COMPANY ARE DIVIDED AMONG EMPLOYEES

Each month there is a division of the profits of this factory among the employees of the Company This division is based on the length of service in the Company and the number of locks produced in one month The percentage paid to employees are shown in these groupings

Number of locks produced in one month	Group "F" 3 months to 1 year of service	Group "E" 1 year to 2½ years of service	Group "D" 2½ years to 5 years of service	Group "C" 5 years to [illegible]	[illegible]	[illegible]
300,000	3½%	4%	4½%	5%	5½%	6%
400,000	4	4½	5	5½	6	7
500,000	4½	5	5½	6	7	8
600,000	5	5½	6	7	8	10
750,000	5½	6	7	8	10	12½
900,000	6	7	8	10	12½	16⅔
1,000,000	7	8	10	12½	16	20
1,250,000	8	10	12½	16⅔	20	25
1,500,000	10	12½	16⅔	20	25	30

FIG. I. CARD SHOWING PROFITS AVAILABLE FOR EMPLOYEES



YOUR LIFE INSURED

Every employee of the Miller Lock Co has a **Life Insurance Policy** carried (**Free of Charge**) for the benefit of his dependents This insurance starts when the employee has been in the service of the Company three months It is arranged according to the following groupings

[illegible]	Group "F" 3 months to 1 year of service	Group "E" 1 year to 2½ years of service	Group "D" 2½ years to 5 years of service	Group "C" 5 years to 7½ years of service	Group "B" 7½ years to 10 years of service	Group "A" over 10 years of service
Married	$400	$500	$600	$700	$800	$1000
Single	$250	$300	$400	$500	$600	$750

YOUR HEALTH INSURED

Good Health is essential to Happiness Facilities are maintained by the company for the benefit of the health of its employees

If you are ill or inclined to be ill, the dispensary is at your service

In addition to our medical advisor, arrangements can be made for dental treatment at the plant or advice given regarding optical treatment

FIG. 2. REVERSE SIDE OF CARD SHOWN IN FIG. I

to either take or reject the offer for a position, by the first day or first week's pay envelope. Later he may think about the future, but his mind is compelled to act quickly and his whole psychology is based upon either "taking a chance" or "not taking a chance."

During the probationary period the company has a chance to prove itself and the new employees have a chance to show their character and ability. In these days of stringent labor shortage the new employees may not come up to the standard and will still be retained because of a lack of someone to take their place should they be dismissed.

On the other hand, this same labor stringency compels the manufacturer to come up to the standards set, and he should go a little further and beyond the expectations of the employee who is new at the plant. Manufacturers are now competing with one another in a race for the highest standards of industrial betterment, and the wage earner is most critical.

Standard of Profit Sharing

The standard of profit sharing in any plant is not reflected by the printed matter that tells about it. It is not the standard that the employment department gives the applicant for work. It is not the amounts shown on the profit side of the company's books each year or month. The standard of profit sharing that the new employee receives when he starts to work is that standard that is in the minds of his fellow workers who transmit to him the profit-sharing idea—good or bad.

If the employee is to stick on the job long enough to share in the profits of the company he will stick because of the fact that he sees other men and women, who have been working in the plant for some time, getting that envelope with their share of the profits of the company. The vast majority of men and women are envious. This envy is paramount among the industrial classes, as anyone will admit who has studied the psychology of the factory in any generation. When Jim, Bill, John and George have cash handed out to them in the shop because they have been in the factory long enough to participate in the profits of the company, then Harry (the new employee) will want to know right away "why he didn't get some." The seed of profit sharing can be planted, given sunshine and plenty of water, but it will not germinate except in sight of the actual cash in a fellow employee's hand. We Americans are not imaginative. We are a practical set of people who want to be shown. This "show me" is at the heart of every *successful* profit-sharing plan, and will be the best means of getting steady workers from the new employees who are in the doubtful list.

Miller Plan of Distribution

The plan for the distribution of profits as published by the Miller Lock Company, is distinctly just and equitable. It is in exact proportion to the profits of the corporation itself—no guess work about it. The employee always knows what his share is. If there is a mistake he can figure the thing out himself without asking the help of the accountant. Over 46 per cent. of the profits of the company are paid to employees in dividends.

The company has carefully figured its costs and laid out a plan by which the total amount of profits distributed to its employees was to be a certain proportion of the profits distributed to its stockholders. This amount was then divided so that the employees would participate in proportion to the length of their employment and their value to the company (this being measured by their monthly earnings). The employee is paid his share of the profits upon the number of locks produced in the entire plant.

This makes every employee pull together to get out as many locks as possible. The salesman may not be a producer any more than the office boy or the fireman in the power house. But their share in the profits are all on the same basis. If the office boy loses a card that effects production he hits his own purse strings, just the same as the fireman who lets his steam get so low that there is not enough power to run the plant.

Schedule of Profit Sharing

It is a known economic fact that an employee who has been in the services of the firm a year is worth more than the one who has been on the pay roll but six months. The employee who has been with the company ten years has caught the *espirit de corps* of the company and organization and is worth a great deal more than the man who has been working with the company only a year. For this reason there is a sliding scale of percentage of profits the amount of increase advancing as the period of service advances. See the schedule card illustrated in Figure 1.

Our profit-sharing list is called the "Honor Roll." A new employee must serve three full calendar months before he is entitled to have his name on this roll. The books of the company are opened once each month, on the first, to admit the names of the new partners in the business.

Those who are new members of the honor roll are classed in group "F." They consist of all employees who have been with the company three full calendar months or more, up to one year of service. If we should happen to manufacture only 300,000 locks during the first month on the honor roll the new employee would receive only three and one-half per cent of his wages for the same period of time. On the other hand if we should manufacture 1,000,000 locks during the month the new member of the firm would receive dou-this amount, or seven per cent. as his share. Should we manufacture 1,500,000 locks in a month the new partner should get ten per cent. of his wages. We have a capacity for the last named amount, but our largest monthly production so far has been slightly in excess of 1,000,000 locks. The various percentages are paid to the new employee for the number of locks between 300,000 and 1,500,000. For 400,000 four per cent. is paid; for 500,000 four and one-half per cent.; for 600,000 five per cent.; for 750,000 five and one-half per cent.; for 900,000 six per cent., and for 1,250,000 eight per cent. is paid.

After an employee has been with the company a year he becomes more valuable and is promoted into group "E" where the percentages paid are greater, varying from one-half of a per cent. to two and one-half per cent. more than in group "F."

In a year and a half the employee is again advanced to a position of controlling more stock and is placed in group "D," which is composed of all employees who have been with the company from two and one-half to five years. In moving to the new group there is an increase in the basis of percentage paid from one-half of a percent. to over four per cent. greater than that paid in the schedule of group "E."

Then there is group "C" which is for employees who have been with the shop from five to seven and one-half years, which is an increase over the next lowest grouping. Then comes group "B" for persons who have been in service from seven and one-half to ten years with its increase in profits paid.

Group "A" is the final and coveted group. These are the veterans of the company. Every one of them has been with the company at least ten years and many of them have been continuously employed by the Miller Lock Company for over 25 or 30 years. The smallest amount in group "A" is six per cent. of the monthly earnings and the largest is thirty per cent. The scale of production makes jumps in this class from one to five per cent.

The Clock of Production

In the recreation room of the company is a monster clock (Figure 3), which reads across the face in large letters "A MILLION LOCKS THIS MONTH." This is the employees' record of production and is watched just as keenly by the laborer as it is by the works manager. On the first day of every month all through the plant men and women are anxious to see the clock and know the final earnings for the month that ended the day before. As soon as they know the production they can figure their own share of the profits, taking their total earnings for the month just ended and calculate the amount of profits by using the percentage of their group for the number of locks produced.

The dividends are paid every month on the last day of the month for the production of the preceding month. This affords an opportunity for the pay department to total the monthly figures, apply the proper percentages to each individual and make the reckonings on the emloyees' pay-roll sheet. This method also tends to hold persons in employment; for once a man has earned his share of the profits he wants to get them. Just as soon as they are paid another month has come around and he still has some more money coming to him in profits. So the chain works from month to month.

At one time in our company a new employee had to wait over a year before sharing in the profits of the company. We felt that this was too long and that a shorter time would be more equitable. The advantage of the shorter time was shown the writer recently when an effort was made to get an old employee back into the fold.

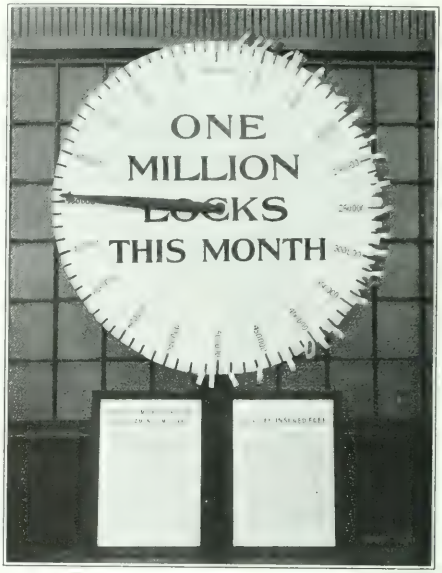


FIG. 3. PRODUCTION RECORD CLOCK IN RECREATION ROOM

Advantage of Monthly Payment of Dividends

The young lady in question had been with the company for over seven years and had left to go to a nearby plant. When the writer asked her to return she just smiled and said "No, I like my work, and besides if I did go back to the lock works I would lose all of my Honor Roll profits that I had spent years in building up." It was called to her attention that things had changed since she had started with the company seven years ago and that it now required only three months of service to get on the Honor Roll again. This had not been told her before, and after reflecting a minute on the new idea she replied, "Now that sounds real attractive and I'll try and make arrangements to come to work."

Every profit-sharing plan should provide more profits for the older employees. Our plan can be improved by arranging an increased dividend for men after 15, 20, 25 and 30 years of service. These older employees have in many cases given their lives to the company and should be entitled to a larger reward than the man who has only given 10 or 12 years.

The profit-sharing era is just dawning. Throughout the war, and after the war it will advance by leaps and bounds. The men who have gone to the front are going to return with a demand that they be given the opportunity to get their fingers on some of the financial fruits of their work.

The profit-sharing idea is popular. It is so just that capital is more and more willing to face it honorably, while labor is willing to see in it a panacea for many of its differences with the money interests. Every manufacturer will do well to start at once to plan his own system of profit sharing if he wants to be able to meet the approaching era of a common understanding between capital and labor.

Electric Heat for Drying and Baking

Types of Industrial Apparatus That Have Had a Rapid Development During the Past Five Years

By George J. Kirkgasser

Electrically heated ovens for the industrial processes of drying and baking divide into three main types: Kiln or box; semi-continuous conveyor; continuous conveyor. These are used for drying japans, enamels and varnishes, for baking cores, for sherardizing, and for gun shrinking. Ovens of these three types for all these purposes are fully described, and several illustrative problems show how to compute the current consumption for various furnaces on a heat unit basis.

Mr. George J. Kirkgasser *from 1907 to 1909 was engaged in electrical construction work, then for two years was electrical and fire hazard inspector for industrial plants in the western part of the State of New York and assistant engineer for the Underwriters Laboratories, Inc., for that section. In 1910 he became connected with the Cutler-Hammer Manufacturing Company of Milwaukee, handling the relationships of that firm with engineering publications and the technical societies. In 1913-14 he wrote and published "Electric Lighting and Motor Wiring" and has been a frequent contributor to the technical press. He is a graduate of Syracuse University in electrical engineering.*

As mentioned in my article in the November issue, page 417, the use of electric heat in place of gas or other fuel for industrial processes as drying, baking, etc., has developed considerably during the past five years, because of its reliability, cleanliness, ease of control, safety and reduced fire hazard, and speed. In some locations where a goodly supply of natural gas has always been available, shortages have occurred forcing manufacturers to look to some other heating agent.

Ovens are employed for many purposes and vary in size and method of operation. Where only drying is to be done, and the temperature must be kept somewhere between 100 and 200 degrees Fahrenheit, the type of space heater shown in Figure 15 of the November article, or the grid type unit may be employed. Such low temperature drying ovens are used for drying clothes, macaroni, printing ink, herbs, varnish, ammunition shells, armatures, etc. Food warmers or cabinets are also in this class.

Japanning and enameling require higher temperature, usually in the neighborhood of 400 to 450 degrees Fahrenheit, and grid or ribbon type heater units are used. Ovens of this kind are installed in scores of industrial plants for japanning or enameling metal furniture, automobile parts, metal signs, motor frames, brass beds, telephones, metal conduit, stoves, metal boxes and a hundred and one other articles.

The adoption of electric ovens by such representative firms as Dodge Bros., Willys-Overland, Hudson, Burroughs Adding Machine Co., Packard, Crown Cork & Seal Co., DeLaval Separator Co., Studebaker, Reo, Midvale Steel, Western Electric and others has been very successful. It has been found that lowest cost of production has been made possible despite the fact that unit for unit electricity costs more than gas.

But just as gas, although costing more than coal, was able to lower cost of production, so also does electricity make it possible to produce in many instances at a lower cost than with gas.

Japanning was first accomplished by the use of liquid lacquer or varnish derived from vegetables grown in Japan and baked in the sun. Today the word japan has a much wider meaning, and the protective or decorative coating is baked on by artificial heat. If not properly done imperfect work results, the rejections in many cases running over 50 per cent.

Through the application of electric heat most of the uncontrollable variables entering into japanning, work have been practically eliminated. Definite results can be secured and if one batch of work is satisfactory, others following under similar condition will be finished satisfactorily.

Electric heating units because of their portability can be located in such places as to insure the best temperature distribution. Since the control of the current and, therefore, the temperature, is simple, the variables of the human element are reduced.

Major Hirshfeld, formerly of the Detroit Edison Co., says the japanning in one large plant has been reduced to what is practically an absolute basis. In this plant automatic control is used throughout, one individual located in front of an instrument board a distance from the ovens, having general supervision and being responsible for the process and results.

The time for baking electrically is one-half or less than with gas heat, since a higher temperature can be maintained.

Why Electric Heat Bakes Faster

In a direct-fired gas oven the heat is transferred to the work through convection—that is, it is carried to it by the hot gases. In an electrically heated oven some heat is brought to the work in this way and the balance by radiation which probably penetrates more and accounts for the more rapid setting of the coat of japan under the surface.

Heat that is obtained in the usual way from fuel requires a combustion process with the oxygen of the air. Complete combustion is almost impossible, since the mixture of the fuel and air varies and cannot be controlled with great accuracy. So much more fuel and heat are required to do a given amount of work because so much heat is discharged into the atmosphere and so much of the fuel is not converted by mixture with oxygen into heat.

The application of electric heat to ovens depends upon local conditions. In some ovens it may be necessary or sufficient to install the heaters along the side walls, while in other cases it may be necessary to supplement the heaters on the side wall with one or more rows down the center of the oven.

The number of heaters for any given installation depends upon the weight of material baked, maximum temperature required, time required in which to reach maximum temperature, ventilation or changes of air per hour, location of heaters, and oven construction.

In the majority of enameling oven installations the maximum temperature will be from 400 to 450 degrees Fahrenheit, which will be reached in from one-half to one hour's time. The ventilation or changes of air per hour will depend upon a number of variables, such as kind of enamel used, speed of baking, maximum temperatures, and oven construction. This will vary through a range of from 10 to 20 complete changes of air per hour.

In many cases, due to interference of trucks, conveyors or work, the heaters may extend only a definite distance above the floor line, in which case it is necessary to place part of the heaters elsewhere to get sufficient heat in the oven.

The heating element of the Westinghouse oven heaters (Figure 1) consists of a resistor ribbon wound on a number of fire clay bushings assembled on two steel tie rods, between two pressed steel end-plates. The ends of the ribbon are secured to forged steel terminals which are clamped to the steel tie rods, the rods therefore becoming the terminals for the heaters. These rods are insulated from the end frames where they pass through, and the ends are threaded for bolting on the connectors.

The heaters are normally rated at 2.5 kilowatts, 120 volts. Any number of these heaters may be installed in an oven, and connected to any single phase, or polyphase, alternating current, or a direct current 110, 220 or 440 volt power circuit that may be available. On 220-volt service, two heaters are connected in series. Where three-phase power circuits are used, the heaters are connected in what is known as three-phase delta.

Another type of oven heater is shown in Figure 2, and an installation of heaters in a furnace in Figure 3.

Overcoming Old Ideas

Japanners have heretofore accepted as inevitable a higher temperature near the back of the ordinary kiln or box-type oven than that prevailing near the door; they have also accepted as inevitable a higher temperature near the ceiling than near the floor. With electric heating units of the proper sort, it is just as easy to hang heaters on the doors as it is on the stationary walls, and it is equally easy to place them on the floor. This makes it possible to obtain a practically uniform temperature distribution throughout the entire oven, and this leads to high quality, and high speed. In the long, continuous type of oven so arranged that the work is carried through on a conveyor, there is some combination of temperatures along the run of such an oven that will give the best work in the shortest time and the flexibility of the electric heating units adapts them ideally to the determination and the maintenance of such combinations.

The work processed in an electrically heated oven is heated largely by energy radiated from the hot metal of the heating units and only to a slight extent by convection currents. Microscopic examination has shown that both quality and speed improve as the proportion of heat transferred by radiation increased, and an oven in which heat transfer by convection could be entirely eliminated should give maximum quality and speed.

In japanning and enameling ovens heat must be supplied for the following chief purposes:

1. Raising the temperature of the work.
2. Raising temperature of parts used for supporting or carrying the work.
3. Raising the temperatue of the ventilating air.
4. Supplying the loss which occurs from the external surfaces of the oven, known as radiation losses.
5. In case of intermittent operation, such as a kiln type oven or the semi-continuous conveyor type oven, raising the temperature of oven walls and heating equipment.

The material is usually at room temperature which is approximately 70 degrees Fahrenheit. This must be heated from room temperature to the maximum temperature desired. After the work has reached its maximum temperature, no additional heat is absorbed by it regardless of the length of time it may be held at that temperature, as a certain definite amount of heat is required for raising the temperature of a given substance through a given range in temperature, irrespective of the length of time consumed in heating. However, if the heating is accomplished in one hour a certain amount of current demand will be required, but if the heating is accomplished in one-half the time, double the amount of current expressed in kilowatts will be required with exactly the same kilowatt hour consumption. The total weight in pounds of metal or work heated multiplied by the degrees rise in temperature or the difference between the initial and maximum temperature, multiplied by the specific heat of the metal gives the power required in B.t.u.'s. The specific heat of iron, which is the heat in B.t.u.'s required for raising one pound of substance 1 degree Fahrenheit is 0.125.

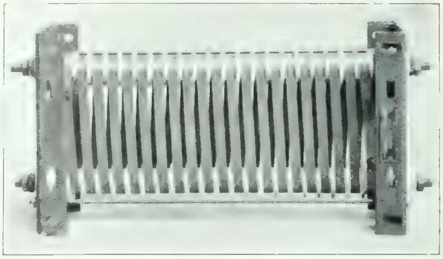


FIG. 1. WESTINGHOUSE TYPE C OVEN HEATER UNIT

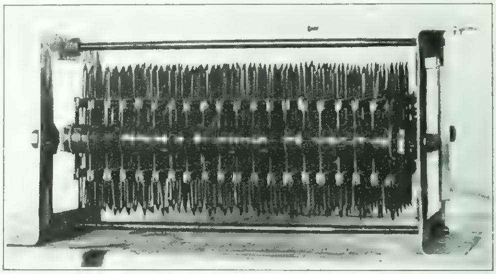


FIG. 2. CUTLER-HAMMER RIBBON TYPE GRID JAPANNING OVEN HEATER

For example:

Weight of work baked per hour, 3,000 pounds.
Initial temperature, 70 degrees F.
Final temperature, 450 degrees F.
Length of bake, 1 hour.

$$3000 \times (450 - 70) \times 0.125 = 142{,}600 \text{ B.t.u.}$$

$$\frac{142{,}600}{3412} = 41.8 \text{ kw. hours.}$$

The item of raising the temperature of the parts used for supporting or carrying the material to be baked cannot be neglected as quite often the conveyor or supporting racks or trucks will weigh as much as the work itself. However, the conveyor or trucks may be at some higher temperature if the conveyor or trucks re-enter the oven before they have time to cool off to room temperature. As in the case of the work entering the oven, it is important to know the initial and the final temperature of the conveyor or supporting racks or truck.

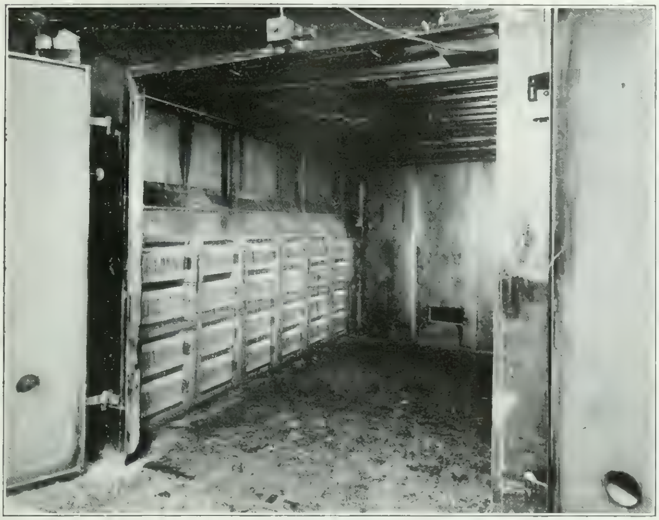


FIG. 3. CLOSE-UP VIEW OF RESISTORS MOUNTED BEHIND PROTECTIVE SCREEN IN A TRUCK-LOADED ENAMELING OVEN

For example:

Weight of movable truck or conveyor entering the oven per hour, 1,500 pounds.

Initial temperature, 150 degrees F.

Final temperature, 450 degrees F.

$$1500 \times (450 - 150) \times 0.125 = 56{,}250 \text{ B.t.u.}$$

$$\frac{56250}{3412} = 16.5 \text{ kw. hours.}$$

HEATING AIR NECESSARY FOR VENTILATION

Ventilation being necessary for certain kinds of baking, it is important to consider the power needed.

The amount of power required for heating the air used in the ventilation of the oven depends upon the initial and final temperature of the air, the pounds of air entering, and its specific heat. Since the ventilating air is obtained from the enameling room, the initial temperature is assumed at 70 degrees. The final temperature will be that of the air leaving the oven. In the case of the kiln type oven or semi-continuous conveyor oven, the air is withdrawn at the maximum oven temperature, but with a continuous conveyor type oven where the incoming work is bathed by the outgoing air, the temperature of this ventilating air at the exhaust point may be considerably below the maximum over temperature. A kiln type of oven is shown in Figure 4.

The total quantity in cubic feet of air supplied per hour, multiplied by the temperature rise in degrees Fahrenheit, multiplied by the specific heat of air, divided by the cubic feet of air per pound, will give the heat required in B.t.u.'s for ventilating purposes. The specific heat of air at 450 degrees Fahrenheit is 0.245. At 450 degrees Fahrenheit there are 22.9 cubic feet of air per pound.

The following example as given by Mr. Wirt Scott of the Westinghouse Company serves to illustrate the working out of a concrete heating problem. Assume that 10,000 pounds of sheet metal are to be enameled per hour, at a maximum temperature of 450 degrees Fahrenheit, entering the oven at 70 degrees and leaving at 300 degrees. The oven is of the continuous type, the work being hung on the conveyor, dipped automatically while traveling, drained, and conveyed continuously through the oven. The oven is in the form of a room similar to that shown in Figure 5, 27 feet wide, 54 feet long and 8 feet 6 inches high, with insulated walls consisting of four inches of high-grade insulating material. The conveyor travels at a speed of six feet per minute and weighs 12 pounds per foot, giving a total weight of 4,320 pounds per hour. It will enter the oven at about 150 degrees and leave at 450 degrees. About 12,400 cubic feet of ventilating air are used per hour, with a temperature rise of 380 degrees Fahrenheit. The radiation loss area of the walls is 4,293 square feet, having a surface temperature of 100 degrees Fahrenheit and a radiation constant of 0.6. The total heat requirements per hour are:

	B.t.u.	K.w. hours	Watts per unit
Radiation	225,400	66.1	15.4 per square foot
Conveyor racks	162,000	47.5	11 per pound
Sheet metal load	287,500	84.4	8.44 per pound
Ventilation	514,400	151.0	12.2 per cubic foot
Total	1,189,300	340.0	

Absorption by the walls is not considered in a continuous type oven. In this special case, 156 heaters with a maximum demand of 360 kw.-hrs. were necessary. This resulted in 28.7 pounds of material being baked per kw.-hr.

In large plants electric current is purchased or generated at a cost of two cents a kw. hr. or less.

TYPES OF ELECTRICALLY HEATED OVENS

Ovens are divided into three main types:

1. Kiln or box type
    - (a) Hand-loaded
    - (b) Truck-loaded.

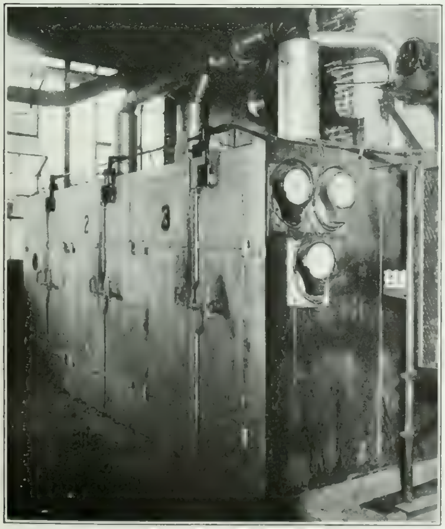


FIG. 4. PIPING FOR VENTILATING THREE KILN-TYPE ENAMELING OVENS

2. Semi-continuous conveyor type
3. Continuous conveyor type

In the first, the work may be carried in and hung on hooks or other supports by hand, or the work may be first placed on trucks and the entire truck pushed into the oven and left there during the bake. The latter can be quickly removed and another loaded truck placed in the oven. See Figures 6 to 10 inclusive.

The semi-continuous conveyor type oven consists of an oven having doors at both ends with an overhead conveyor running directly through it. This is usually a continuous chain passing through the oven and returning over the top. A batch of material is dipped in the enamel and hung on the conveyor to drip for 15 or 20 minutes and then carried into the oven by the conveyor. See Figure 11.

While the first batch is being baked, the second is being dipped and being hung on the conveyor. As soon as the first batch has baked the conveyor is started up, the first being carried out, and the second batch into the oven. A third batch is then dipped and hung on the conveyor, while the second batch is being baked, and the first batch removed from the conveyor. This operation is repeated indefinitely.

A continuous conveyor-type oven consists of an oven with a conveyor running through it which operates continuously and not intermittently as in the case of the semi-continuous oven. The work is hung on to a moving conveyor or chain and carried directly into the oven. The speed of the chain, the length of travel and the temperature of the oven must be such, that by the time the work reaches the exit, the enamel has been thoroughly baked. Ovens of this character require the doors to be open continuously. In order to prevent heat losses through these openings and the smoke and vapors from filling the enameling room, the oven must be constructed so as to obtain an air seal around the opening, or an exhaust fan connected at the proper point of the oven to secure an air balance, and at the same time provide ample ventilation.

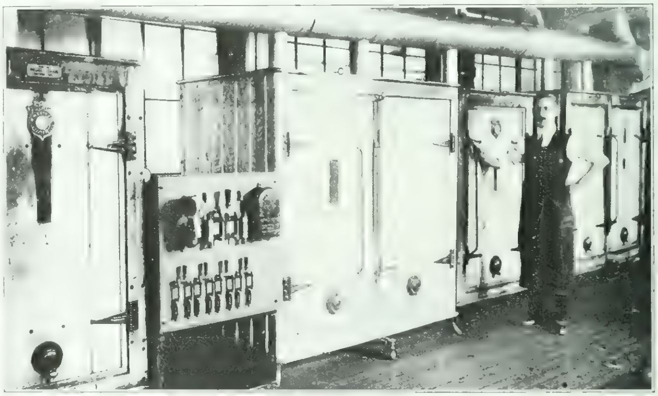


FIG. 6. KILN TYPE JAPANNING OVENS WITH CUTLER-HAMMER AUTOMATIC TEMPERATURE CONTROL PANEL IN FOREGROUND

The hand-operated kiln-type oven is the most inefficient type of oven used. Due to the fact that the work must be carried in by hand, the oven cannot be at a very high temperature during the loading period. Also, after the baking has been completed the oven doors must be opened and the oven allowed to cool down to about 150 degrees F. before the workmen can enter the oven for removing the work. Before the oven can then be loaded, ready to be put into operation again, the temperature is down to that of the room. This means that in almost every case this type of oven must be heated from approximately room temperature up to maximum baking temperature for every bake that is obtained.

With the truck operated kiln-type oven, the doors may be open a much shorter period than where ovens are hand-operated, from 5 to 10 minutes being ample time after the doors have been open for removing the trucks and running other trucks into the oven.

The semi-continuous-conveyor oven is about as efficient as the truck-operated oven because, as the work progresses through the oven, both ends of the oven must be laid wide open when loading, with the consequent result of a large cooling effect. Ovens of this type will drop from 450 degrees to 250 degrees while this change is being made. The total weight of the conveyor in proportion to the amount of work entering the oven per bake is probably not so great with this type of oven as in the case of the truck-operated oven, hence the efficiency of operation is improved in this particular. The overall efficiency, however, is approximately the same as the truck-operated oven.

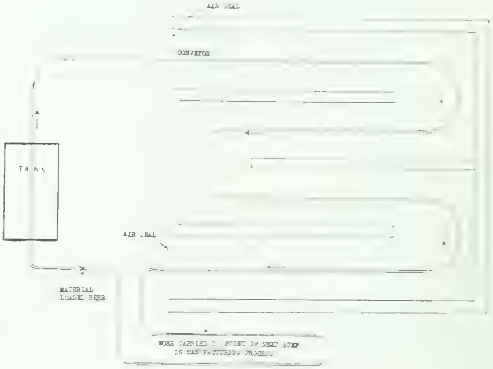


FIG. 5. DIAGRAM OF CONTINUOUS TYPE OVEN

The continuous conveyor-type oven is the most efficient type of oven, it operates continuously at one temperature and requires a minimum of ventilation and a conveyor of minimum weight. The net result of this is that the latest designs of continuous conveyor-type ovens have an efficiency in excess of double the amount obtained by the best semi-continuous conveyor-type oven.

The efficiency of the above types of ovens, expressed in pounds of work or finished product, per kilowatt hour consumption for ovens of the latest of each of the respective types, having the highest grade insulation, proper ventilation and intelligent operation of the oven given by the Westinghouse Company is:

Kiln-type oven, hand operated—6 to 8 pounds of work per kilowatt hour.

Kiln-type oven, truck-operated—10 to 12 pounds of work per kilowatt hour.

Semi-continuous, conveyor-type oven—10 to 12 pounds of work per kilowatt hour.

Continuous conveyor-type oven—25 to 30 pounds of work per kilowatt hour.

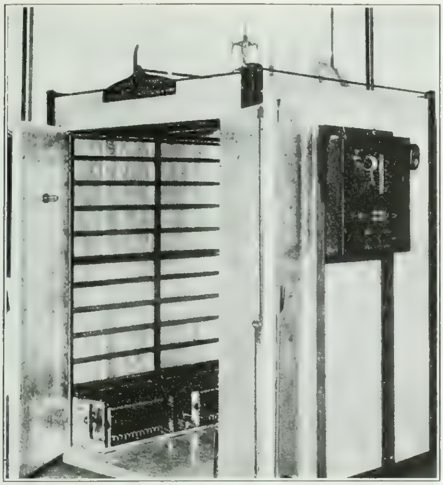


FIG. 7. KILN TYPE JAPANNING OVEN—AUTOMATIC TEMPERATURE CONTROL PANEL MOUNTED ON FRAME OUTSIDE OF OVEN

Cutler-Hammer grid resistors on floor at each side of oven.

STANDARDIZING JAPANNING OPERATIONS

Since the principles of scientific management have been adopted so generally and with much success, the standardizing of japanning, enameling or drying operations is receiving greater attention than has ever been given them. Particularly in quantity production can great economy result when the one best way to perform an operation or process can be discovered and standardized so that henceforth this work is carried on in a similar continuous manner.

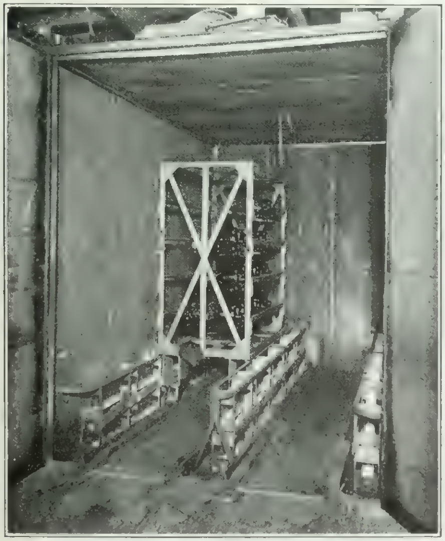


FIG 8. KILN TYPE ENAMELING OVEN WITH WESTINGHOUSE HEATER ON EACH WALL AND IN CENTER

(Parts to be enameled are carried in on rollers.)

Such scientific standardization is well exemplified in the use of the continuous conveyor-type oven. In the hand-loaded kiln type oven the work after being dipped is hung up on racks or supports and then after the oven is loaded, current is turned on and later the reverse of this operation takes place. A large amount of heat is wasted in heating up the oven after each batch and manual handling of material is costly and consumes much time.

With the continuous process which is the one dictated by scientific management, mechanical devices are used to the greatest extent—not only freeing labor for other work but thereby eliminating a source of error and inefficiency. The work is dipped all at once, carried to and through the oven and then to a point where the next operation is to be performed.

With this method all movements and processes may be definitely set and then duplicated in exactly the same manner over and over again. If desired the oven may be so planned and constructed that the work is passed through zones of properly graduated and properly maintained temperatures so that it may be treated and cooled exactly in ways found to be best by experiment.

The ventilation of the continuous conveyor-type oven can be controlled much better because the openings are sealed, and there is no intermittent throwing open of the oven with the resultant cooling off.

At the National Screw and Tack Company's plant at Cleveland gas shortage made necessary the use of electricity for heating its drying ovens and resulted in increased production and lowered unit costs. The ovens are now heated to 400 degrees Fahrenheit in one-tenth the time required under old conditions, due to electric heat and some re-arrangement. Rods that used to be kept in ovens 75 to 90 minutes, are now finished in 20 minutes or less. The daily output was about 18 tons, and now it averages 55 tons.

In another factory an operation was carried on which included, first, the placing of pieces on a rod, which was then carried by two men into an oven where it was hung up. In each bake an average of 35 of these rods had to be loaded and carried into the oven. They were then pre-heated for one to one and one-half hours. After the pre-heat, they were carried out and dipped and then hung up to permit the superfluous liquid to drip off, after which they were carried back into the oven and baked for twelve hours.

This method had been practiced for years in that industry and was commonly used. To electrify this process it was necessary to change the cycle of operation, and eliminate a great deal of the heat loss due to the opening and closing of the oven as well as the cooling off of the material after each step.

To accomplish this, a continuous conveyor-type oven was installed, the operation of which requires the labor of only a man or boy to place the material on a chain conveyor and another to take the finished product from the conveyor as it comes from the oven. All of the former operations are accomplished in the travel of the conveyor.

The saving in labor through the installation of this oven was sufficient in itself to pay for its cost in approximately seven months. In addition to this an uniform product is turned out; the saving in floor space is approximately 75 per cent.; there are no culls; the temperature is held constant automatically, preventing over or under baking, and shop conditions are improved.

This case is one of a great many reported by the Industrial Heating Committee of the N. E. L. A. which necessitated the changing of a cycle of operation and which often meets with some opposition from those schooled in a particular method.

Electrically Heated Core Ovens for Foundries

At the National Metal Congress and Foundrymen's Exhibition held in Milwaukee during the second week of October, 1918, the Young Brothers representative noted a distinctly new and progressive attitude on the part of the foundrymen in respect to electric core ovens. Electric heat is eminently adapted for core drying because of the thoroughness of the drying action of the radiating heat. The cores are baked more rapidly and as a result of any efficiency plan depending on standardizing a process through accurate control of factors, the production is increased, the product bettered, and possibility of imperfectly baked cores eliminated. Enough installations have been made to show that the results are as satisfying as has been effected in the japanning and enameling field. The ovens are similar and the sizes and arrangement of racks depend upon the size of cores to be baked.

Sherardizing Ovens

In the process of sherardizing, which is a means of rust-proofing, the electrically heated oven has now been found extremely superior. This process consists of treating the metal article in zinc dust in such a way that the entire exposed surface is impregnated. The dust used consists of metallic zinc with zinc oxide which can best be uniformly handled by keeping the temperature of the oven constant.

About 10 years ago sherardized metal molding was put on the market in competition with the usual enamel covered conduit used in electrical construction work. Since then sherardizing has been extended to the coating of many iron and steel products, as well as being applied to brass to produce a finish resembling nickel plate.

In the report recently made by the engineering department of the Society for Electrical Development, they cite as an example of saving of sherardized products the case of an automobile manufacturer changing over from brass hub caps to sherardized steel caps. Brass caps running four to the pound at 34 cents a pound would cost 20 cents more per set of four than the steel sherardized caps. On a production of 25,000 caps there would be a saving of $5,000 which could be increased by substituting sherardized steel for other brass or nickel plated parts.

The ovens used for the sherardizing process are of the rotary type and the electric units used permit of controlling the temperature so that the surfaces of the articles reach and maintain the condition most suitable for the best sherardizing. The oven is revolved by a motor and the zinc dust is thus brought in constant and intimate contact with the articles or material.

The heating elements are inbedded in the sides of the drums and current led to them through collector rings mounted on the shaft. This is done because the oven is rotated during operation.

The temperature of a sherardizing oven is considerably higher than that of an enameling oven, the "high" heat at the start being over 700 degrees Fahrenheit. This "high" heat is held until the metal is in a condition to absorb the zinc dust (in which it is packed). "Low" heat is then thrown on for two to three hours to give time for thorough depositing and then the current is thrown off. When the temperature of the oven drops to about 350 degrees Fahrenheit the door may be opened and the material removed.

Gun Shrinking Ovens

In the gun treating ovens as now used in ordnance plants temperatures ranging from 700 to 1,000 degrees Fahrenheit are employed. These ovens are used for shrinking gun jackets in place, being from 15 to 75 feet long and cylindrical in shape. Heat other than electric heat could not be applied very easily, and by proper placing of the electric heater units the necessary uniform distribution of heat is secured.

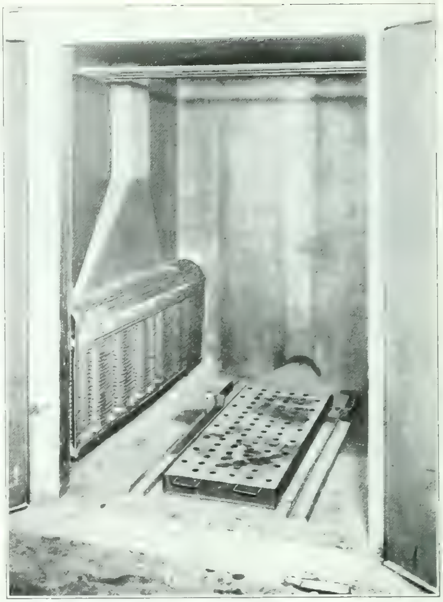


FIG. 9. IN THIS SMALL KILN TYPE OVEN THE HEATER UNITS WITH SCREEN PROTECTION ARE MOUNTED ON SIDE WALLS ONLY

Ventilation at side of rear end of floor.

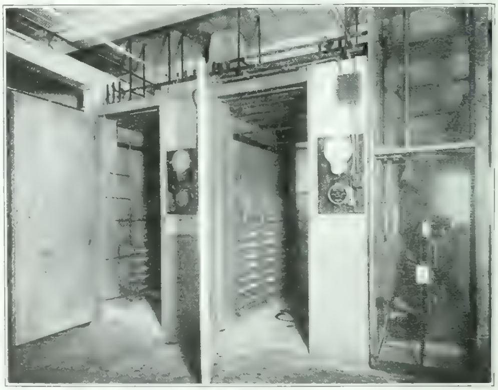


FIG. 10. TWO SMALL SIZE KILN TYPE OVENS FOR SMALL PARTS WHICH ARE LOADED BY HAND

Control of the current is obtained through the small push button station.

Miscellaneous Application

Shelf heaters form a means of applying electric heat to ovens already built or in use, such as are not intended for high temperature work, as the current consumption is not sufficient to give extremely high temperatures. They are suitable for a great variety of purposes, such as: Laboratory closets, lacquering ovens, evaporating

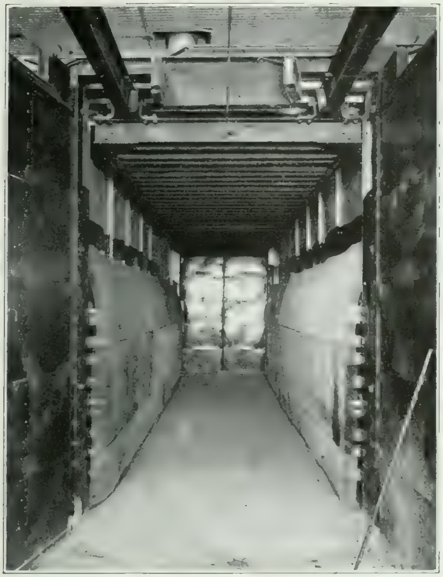


FIG. 11. SEMI-CONTINUOUS CONVEYOR TYPE OVEN—WESTINGHOUSE HEATERS ARE SHOWN MOUNTED AT SIDES

and drying closets, plate warmers, etc. More than one shelf may be used when there is sufficient height and a single shelf does not give a sufficiently high temperature.

Perforated shelves may be made up with space heater units placed below and this arrangement is used for many odd purposes such as keeping oil and grease in quickly usable form in garages, factories, etc.

High temperature metal furnaces will be discussed in the final installment of this series.

* * * *

A Suggestion Sheet for the Designer

By Donald A. Hampson

IN hundreds of smaller shops there is some one man who combines the duties of several positions in his daily work. Such men are fully occupied every minute—mind and body—and when the task includes designing and planning, it is but natural that a wealth of ideas is lacking. The temporary designer finds his abilities somewhat rusty, and his mind does not keep in "live storage" the variety and range of things mechanical that are the everyday tools of his specialist brother. The plant over which he presides does some manufacturing, takes in repair work, special machinery is built, experimental and development work is solicited, jobs are taken on contract. To have in compact form processes and mechanisms—simple and well known but easliy forgotten—one of these men drew up the list given below. A glance over it takes but a moment and usually reveals the very item that is needed but which other matters have driven from the memory. The list is a parallel to the list of adjectives that the "sob" writers are reputed to keep in a handy pigeon hole of their desks.

Castings: Iron, steel, semi-steel, brass, bronze, aluminum, malleable iron, die castings.

Forgings: Hand and power, drop, hammer, forging machine, swaging, cold and hot, extrustion.

Bar stock: Cold drawn and rolled, machinery steel, carbon steel, alloy steel, brass, wrought iron.

Press work: Stamping, drawing, coining, forming, pressed steel, sub press.

Odd materials: Leather, bakelite, mica, paper, rawhide, fiber, rubber, glass, wood, bone, asbestos, cement, lead.

Coatings: Paint, tin, galvanize, japan and enamel—air dry and bake—varnish, lacquer, coloring—brush, spray, dip.

Transmission of power: Belt, shaft, gears, chain, electric.

Gears: Spur, bevel, spiral, crown, internal, worm, elliptical.

Chain: Open and stud link, roller, block, link belt, silent.

Sources of power: Steam, electricity, gas and oil engine, water.

Mechanical movements: Crank, eccentric, cams, planer reverse motion, intermittent gears, frictions, screw, lever, wedge.

Speed changes: Step cone pulley, plain cones, electric motor, gears, frictions.

Feeding: By hand, semi-automatic, automatic, chute, hopper, chain.

Quick return: Cam, weight, spring, Whitworth, gear or belt shift.

Pressure: Screw, weight, lever, spring, wedge, hydraulic, pneumatic.

Springs: Coil, flat, taper leaf, spring pack.

Welding: Forge, electric, oxy-acetylene, thermit.

Assembling: Bolt, rivet, screw, weld spin, solder, braze.

Heating: Coal, gas, electricity, oil, steam.

Methods of manufacturing: Assemble commercial stock parts, special machinery, screw machine work, special tools and fixtures on standard machine tools.

Jig and experimental work: Make the work the moving piece, make the fixture or machine the moving piece, try the piece in every other position, reverse the entire motion or cycle or order of operations, try wet and dry, use suction or air blast, for holding use mechanical, magnetic, electric, pneumatic, or hydraulic means, arrange fixtures to hold several pieces at once.

* * * *

Value of Employment Department

THE economy of installing employment departments is already apparent. The Dennison Manufacturing Company found that, during the first two years of their employment department, a reduced turnover had netted them a saving of $25,000, charging $50 to the cost of replacing each experienced hand. The Curtis Publishing Company estimated that, in one year after the introduction of a centralized employment bureau, there had been a saving of $90 per person "landed on the books" because the applicant accepted was almost sure to "make good." In 1914, the Ford Motor Company introduced the centralized employment bureau. The policy of the bureau is to transfer a man as many as 6 or 8 times until a place is found where he can do the work and earn his $5 a day. This policy reduced the discharges from 8,390 in 1913 to 27 in 1915.

The Hayes Manufacturing Company of Detroit, cut their turnover in two in the first year of the operation of an employment bureau and in the next four months the turnover was more than cut in two again. More significant even is the fact that this reduction was accompanied by a 30 per cent. increase in output per man. —*Hiring and Firing*—a bulletin issued by Metropolitan Life Insurance Co., New York.

Graphic Production Control—IV

Controlling Materials and Operations

By C. E. Knoeppel

Six of the laws of production control are recognized and followed in explaining methods for graphically controlling materials and operations. They are: Scope of control; draw versus push; requirements, importance and availability; operations; materials. Fourteen illustrations from Mr. Knoeppel's *practice show typical graphs for these control processes.*

Mr. C. E. Knoeppel, *founder and president of the firm of* C. E. Knoeppel & Co., Inc., *consulting engineers, served through the shop as molder, draftsman and designer in the plants of several representative manufacturing firms. Later he became an expert systematizer. After specializing on analytical work in factory management he was in the employ of a number of industrial establishments, and was associated with three different firms of industrial engineers. This experience ultimately led to the founding of the organization of general consulting and management engineers and experts of which he is now head and director at* 101 *Park Avenue, New York City.*

"HEY there! Where are you going? Can't you see that stop sign facing you? Back up and keep your eyes open."

With these words to a careless autoist, one of the efficient New York traffic officers went about his business "controlling" the endless procession of automobiles that is in daily evidence on the principal New York streets.

Imagine, you readers who have been to New York, what would happen daily at Fifth Avenue and 42nd Street, if there were no traffic cops in evidence. Progress of automobiles would be much slower, congestion infinitely greater, accidents would be a common sight and the poor pedestrian would have a sorry time of it trying to dart in and out of traffic to cross the street.

The traffic cop in any city is the best personification of Graphic Control that I know of.

Now imagine a factory where material is allowed to flow at will, where there are no "stop" and "go" signs, where no one in particular is in charge of controlling the movement of materials and you have much the same conditions—congestion of material, slow progress, lost parts, failure to maintain schedules and the like.

If it is necessary to control the movement of automobiles, trucks, street cars and people in our cities, it is just as necessary to control the movement of material in our factories, as there is a deadly parallel between traffic and material handling.

Material is, of course, only one of the four factors mentioned in the previous paper—material, labor, equipment and operations. Yet it is the writer's firm conviction that the first step in efficiently controlling production is the proper controlling of material. Material must be purchased, received, stored and moved before it can be used. Sometimes it is necessary to go back days and often weeks and months, from the time material is wanted, in the process of ordering material to be ready for the delivery of finished goods. In one case coming under the writer's notice, certain parts should have been ordered six months before they were ordered, that completion might be as per schedule. In another case it was found in manufacturing a machine that work on the smallest part as against that on the largest part, varied as 180 to 1. Imagine, if you will, starting both of these parts at the same time.

In other words, given equipment on which to work, having labor in readiness and knowing what operations to perform, nothing can be done without material on which to work, the moral of which is—*get the material and control it*—as the first step in controlling production efficiency.

In the second paper certain laws of control were outlined. The author's idea is to use these laws in presenting this paper.

As you will remember the fourth law (requirements) outlined the necessity of knowing what should be made, sufficiently in advance to allow time to plan and schedule. This spells some form of ordering from the Sales Division to the Manufacturing Division, which can be taken by the Control Department and converted into production orders. Order forms are so well known in industry that we will not take up valuable space in reproducing one. Manufacturing orders may contain a number of different items but production orders should be written for one item only, and across the top should be a 1 to 31 scale, to be used as a date follow up through the use of colored signals, as in Figure 23 herewith.

The second law (scope of control) should also be observed if we are to control production comprehensively. Reference to Figure 3, page 287 of the October issue, second paper, shows a manufacturing control and schedule covering purchasing, jigs, machining, sub-assembly and erection work and should be reviewed in connection with this discussion.

Now we come to the sixth law (importance and availability). On receipt of an order, we arrange to split up the total manufacture into a series of assembly units and in doing so we recognize the third law (draw versus push), as per the following:

ASSEMBLY ANALYSIS

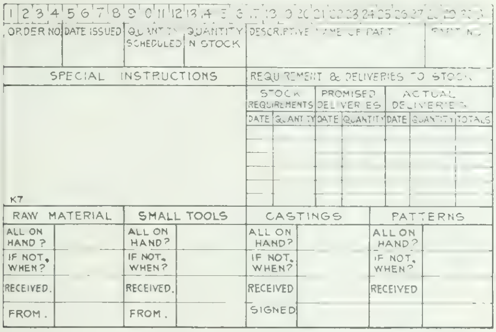
Front Axles
Wanted—1000

Order 13,805
Date—10/5/15

Name of Part	Part Number	Drawing Number	Number of pieces	Number of hours	Buy or make
1. Front Axle I Beam	304	30056	1000	733—1	M
2. Front Axle Bushing	131	10772	2000	266—4	M
3. Front Axle Bushing	132	10773	2000	166—7	M
4. Steering Knuckle, R. H.	418	10774	1000	350—2	M
5. Steering Knuckle, L. H.	419	10775	1000	350—3	M
6. Steering Knuckle Pin	137	10778	2000		B
7. Steering Arm, R. H.	135	10776	1000	200—5	M
8. Steering Arm, L. H.	136	10777	1000	200—6	M
9. Cross Tube Yoke	139	10780	2000	166—8	M
10. Cross Tube	305	10783	1000		M
11. Steering Arm Pin	141	10781	1000	100—9	. M
12. Steering Arm Pin	142	10782	1000	66—10	M
13. Dust Cap	138	10779	2000		B
14. 5/8 x 11 Tubing			1000		B
15. Pine for Cross Tube			2000		B
16. Castle Nut ½"—20			2000		B
17. Castle Nut 9/16"—18			2000		B
18. Grease Cups No. 000			2000		B
19. 3/32 x 1 Cotter Pins			2000		B
20. ⅛ x 1¼ Cotter Pine			2000		*B*
21. ⅛ x 1 Pine			2000		B

It will be noted that the parts have been listed in order of their importance in assembling, but that while the first part takes the longest time to machine, the third and fourth parts take the second longest time so that from the standpoint of machining, the flow is:

Assembly item	Machining item
1	1
2	4
3	7
4	2
5	3
7	5
8	6
9	8
11	9
12	10



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

ORDER NO. | DATE ISSUED | QUANTITY SCHEDULED | QUANTITY IN STOCK | DESCRIPTIVE NAME OF PART | PART NO.

SPECIAL INSTRUCTIONS

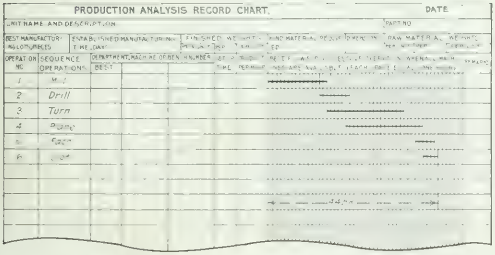
REQUIREMENT & DELIVERIES TO STOCK

STOCK REQUIREMENTS: DATE, QUANTITY | PROMISED DELIVERIES: DATE, QUANTITY | ACTUAL DELIVERIES: DATE, QUANTITY, TOTALS

K7

RAW MATERIAL		SMALL TOOLS		CASTINGS		PATTERNS	
ALL ON HAND?		ALL ON HAND?		ALL ON HAND?		ALL ON HAND?	
IF NOT, WHEN?		IF NOT, WHEN?		IF NOT, WHEN?		IF NOT, WHEN?	
RECEIVED.		RECEIVED.		RECEIVED		RECEIVED	
FROM.		FROM.		SIGNED			

FIG. 23. PRODUCTION ORDER MADE OUT BY CONTROL DEPARTMENT



PRODUCTION ANALYSIS RECORD CHART. DATE

UNIT NAME AND DESCRIPTION | PART NO.

BEST MANUFACTURING LOTS, PIECES | ESTABLISHED MANUFACTURING TIME, DAYS | FINISHED WEIGHTS | KIND MATERIAL REQUIRED | DIMENSION | RAW MATERIAL WEIGHTS

OPERATION NO. | SEQUENCE OPERATIONS | DEPARTMENT, MACHINE OR BENCH NUMBER: BEST | [illegible] | REMARKS

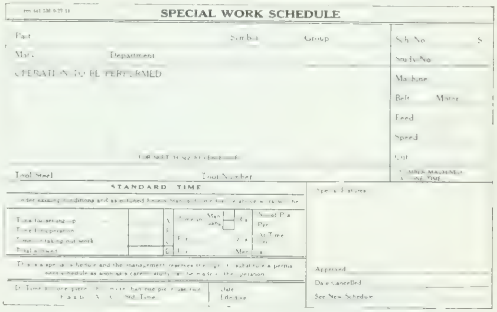
OPERATION NO.	SEQUENCE OPERATIONS
1	Mill
2	Drill
3	Turn
4	Plane
5	Face
6	Slot

34 hrs

FIG. 24. PRODUCTION ANALYSIS RECORD CHART

This furnishes a guide for both machining and assembly. In purchasing, a different sequence may be necessary as it can be readily seen that one of the unimportant parts from the standpoint of both machining and assembly may take the longest time to buy.

The assembly analysis outlined the nature of machining sequence, but as the time expressed was total time, there must be a knowledge of operation flow. The "Production Analysis Record Chart" (Figure 24) takes care of this and is self-explanatory. In this connection we must give consideration to the seventh law (operations), as we could not work up the flow of operations under "Best Flow for Successive Operations" (Figure 24) unless we knew about the operations.



SPECIAL WORK SCHEDULE

Part | Symbol | Group | Sch. No. | S

Mat. | Department | Study No.

OPERATION TO BE PERFORMED

Machine

Belt | Motor

Feed

Speed

Cut

Tool Steel | Tool Number

STANDARD TIME

Time for setting up

Time for operation

Time for taking out work

Total allowed

Special Fixtures

Approved

Date Cancelled

See New Schedule

Date Effective

FIG. 25. SHEET FOR SPECIAL WORK SCHEDULE

In working up this data a "Special Work Schedule" (Figure 25) or something of like nature, should be provided, which furnishes a basis for estimating times, standardizing operations (tentatively) and determining standard hourly productions. As refinements are made, or time study methods inaugurated, permanent work schedules can take the place of the special schedules.

The Control Department has received orders to manufacture and converted them into production orders; worked up a manufacturing schedule; specified flow of parts and operations according to importance and sequence; standardized or estimated operation times and is now in a position to control intelligently the purchase and movement of material, which brings up the matter of purchasing and stores.

It is not the intention of this series to go into details as to the organization of a purchasing department or a stores department. An idea of the functions of both is, however, in order and is set forth as follows:

PURCHASING DEPARTMENT

1. In purchasing, the following should be considered:

A. Demand for the particular article.

B. Saving by purchasing in quantity.

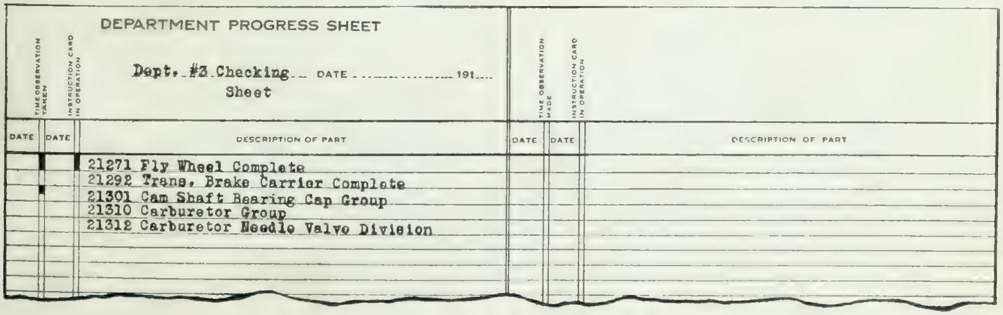
C. Amount of money tied up in stock.

D. Time required to get and use.

E. Possibility of change in the design depreciating the value of the article.

2. Requisitions should be approved by some responsible head before being sent to purchasing department.

3. Purchasing department should maintain an up-to-



DEPARTMENT PROGRESS SHEET

Dept. #3 Checking Sheet DATE .... 191....

TIME OBSERVATION TAKEN	INSTRUCTION CARD IN OPERATION		TIME OBSERVATION MADE	INSTRUCTION CARD IN OPERATION	
DATE	DATE	DESCRIPTION OF PART	DATE	DATE	DESCRIPTION OF PART
		21271 Fly Wheel Complete			
		21292 Trans. Brake Carrier Complete			
		21301 Cam Shaft Bearing Cap Group			
		21310 Carburetor Group			
		21312 Carburetor Needle Valve Division			

FIG. 26. SCHEDULE FURNISHED BY CONTROL DEPT. TO PURCHASING DEPT.

date list of quotations received and prices paid for material.

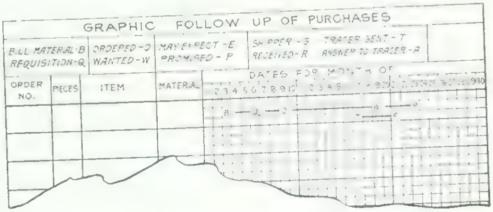


FIG. 27 [illegible] FOR PURCHASES

4. No order should be placed until previous price has been looked up.

5. No invoices should be sent into the plant. Receiving reports from departments (through receiving department) should be checked against the invoices.

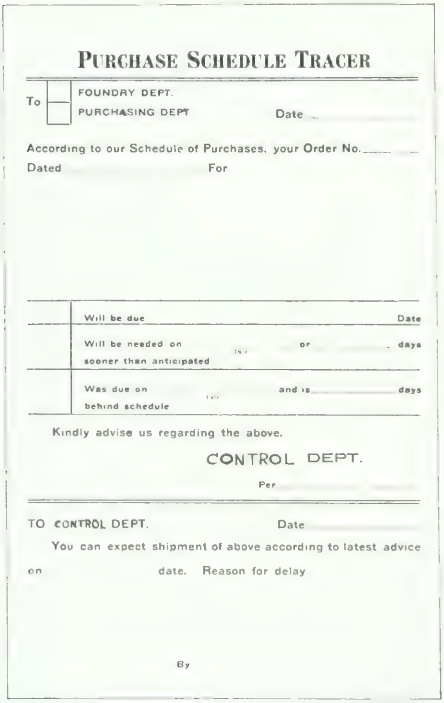
6. Shippers should be made to mark plainly all consignments with order number.

7. The purchasing department should keep after all material ordered from advices received from the Control Department.

8. The purchasing department should maintain a record of spoiled and defective material received, arrange for its return by giving proper notice to the shipping department and charging same back upon shipment.

9. No material should be issued except on requisition.

10. The purchasing department should keep careful records as to shortages and see to it that credit is forthcoming or the amount short shipped and received.



PURCHASE SCHEDULE TRACER

To ☐ FOUNDRY DEPT.
☐ PURCHASING DEPT Date

According to our Schedule of Purchases, your Order No.
Dated For

Will be due Date

Will be needed on or days sooner than anticipated

Was due on and is days behind schedule

Kindly advise us regarding the above.

CONTROL DEPT.
Per

TO CONTROL DEPT. Date

You can expect shipment of above according to latest advice on date. Reason for delay

By

FIG. 28 PURCHASE TRACER FOR PURCHASING DEPARTMENT

STORES DEPARTMENT

1. To know what is needed for most efficient manufacturing.
2. To know where parts are.
3. To have material on hand in proper quantities when it is wanted.
4. To replenish it automatically when it is running low.
5. To prevent tying up too much money in large quantities.
6. To know the amount required for economic running of jobs.
7. To maintain a correct balance at all times.
8. To know that material drawn from stores is charged to some order or account.
9. To keep track of material reserved for orders.
10. To issue nothing except on written requisition.

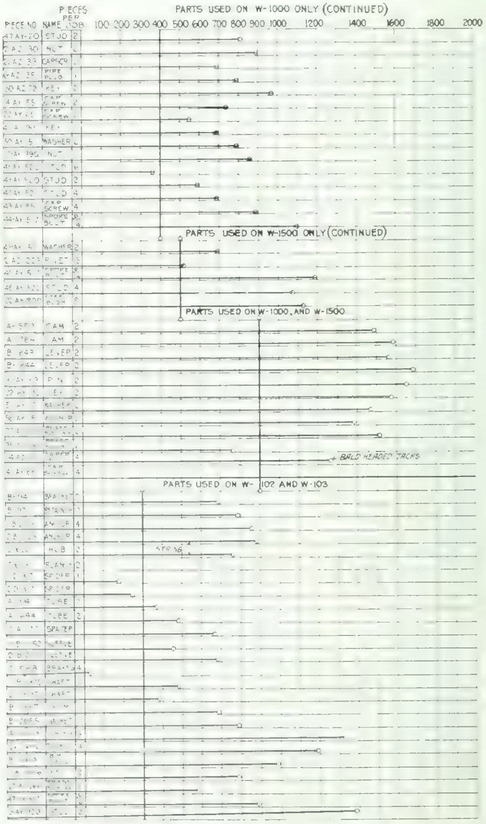
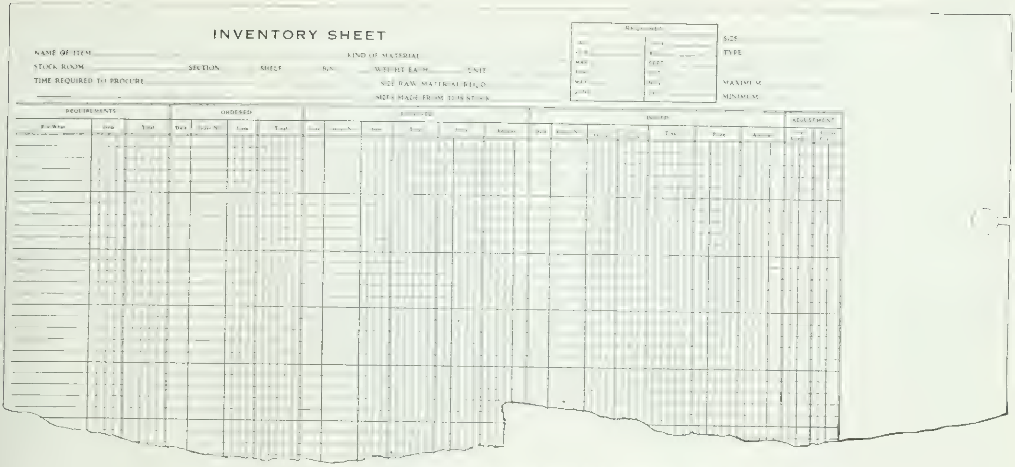


FIG. 29 CONDITION OF MATERIALS FOR PURCHASING DEPARTMENT

As a basis for determining delivery times wanted, the Control Department should work up the following data, *going back from delivery wanted time* (draw versus push), giving consideration to the following:

A. Time to process up to delivery to assembly floor.
B. Time in handling after receipt.
C. Time en route.
D. Time to place order.
E. Time to determine vendor.
F. Time to get prices.

The sum of which would give the total elapsed time to get materials.



INVENTORY SHEET

NAME OF ITEM
KIND OF MATERIAL
STOCK ROOM
SECTION
SHELF
WEIGHT EACH
UNIT
TIME REQUIRED TO PROCURE
SIZE RAW MATERIAL REQ'D
SIZES MADE FROM THIS STOCK
SIZE
TYPE
MAXIMUM
MINIMUM

REQUIREMENTS
ORDERED
ADJUSTMENT

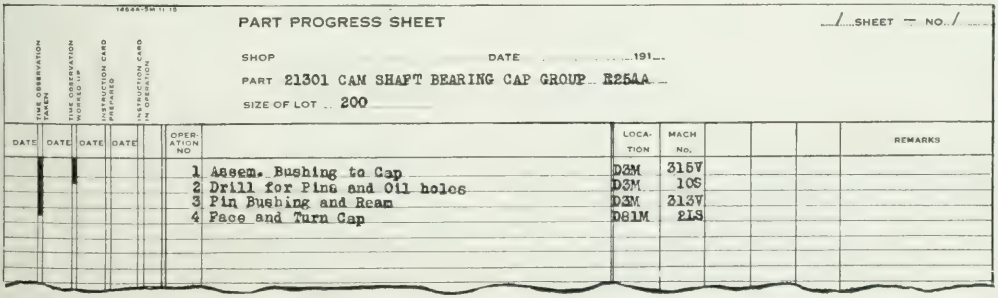
FIG. 30. TOP OF INVENTORY SHEET SHOWING MATERIALS NEEDED, ORDERED AND RECEIVED

From this data the Control Department should give the purchasing department a schedule of purchases showing dates purchasing should start and dates material should arrive. See Figure 26 for a suggested form of schedule. As can be seen, the same kind of a schedule can be given to the tool room covering the making of jigs and fixtures, and to the pattern shop, covering the making of patterns. To maintain a proper follow up of purchased items, a card or sheet record should be maintained (Figure 27) from which a purchase tracer (Figure 28) could be made out and sent to the purchasing department to enable the latter also to keep in touch with progress of an order.

Many will say that it is a mistake to take the function of following purchases away from the purchasing department. My argument is that the purchasing department has the same right to purchase and follow up its own purchases as the manufacturing department has to make and inspect its own product. If the latter is good practice, I have no quarrel with the one who would advocate letting the purchasing department follow up its purchases. It is not up to the Control Department to say what kind of material to buy, nor what price should be paid, nor what concern it should be purchased from. It is an engineering function to specify the kind of material wanted. The purchasing function is to get the kind and exact quality of material specified at the best possible price. It is the function of the Control Department, responsible for getting out production on time and at or near standard costs, to say WHEN, and then follow up the purchase. On this basis we have a proper distribution of responsibility. We have a parallel in the case of actual manufacture wherein the engineering function specifies what should be made, the manufacturing makes, and a disinterested third party, the inspection function, not a part of either and therefore not likely to cover the mistakes of both stepping in and determining the good and the bad.

The purchasing department should be in possession of advance knowledge of material conditions. It is not enough for the stores department to simply advise the purchasing department that certain materials are running low, or send requisitions for purchasing parts to replace depleted stock. The real function of a purchasing division is to purchase at the best time, in the best markets, at the best times and to do this must know the trend of the material situation, must know where too much or too little stock exists, and must know this in advance so as to anticipate what will happen and therefore be in a position to meet salesmen coming in and take advantage of any changes in market conditions that may occur.

To this end it is a good plan to place in the office of the purchasing department a graphic picture of the condition of important materials, this to be kept corrected



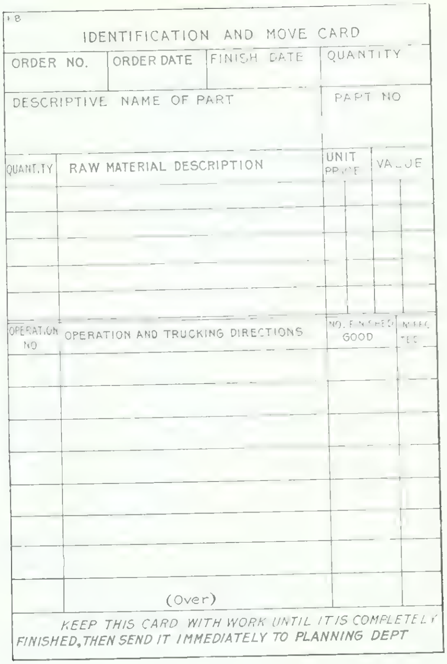
14644-5M 11 18

PART PROGRESS SHEET
1 SHEET — NO. 1

SHOP
DATE 191
PART 21301 CAM SHAFT BEARING CAP GROUP R25AA
SIZE OF LOT 200

TIME OBSERVATION TAKEN DATE	TIME OBSERVATION WORKED UP DATE	INSTRUCTION CARD PREPARED DATE	INSTRUCTION CARD IN OPERATION DATE		OPERATION NO		LOCATION	MACH No.				REMARKS
					1	Assem. Bushing to Cap	D3M	315V				
					2	Drill for Pins and Oil holes	D3M	10S				
					3	Pin Bushing and Ream	D3M	313V				
					4	Face and Turn Cap	D81M	21S				

FIG. 31. PROGRESS SHEET SHOWING LOCATION OF ANY PARTICULAR PART



F 8

IDENTIFICATION AND MOVE CARD

ORDER NO.	ORDER DATE	FINISH DATE	QUANTITY
DESCRIPTIVE NAME OF PART			PART NO
QUANTITY	RAW MATERIAL DESCRIPTION	UNIT PRICE	VALUE
OPERATION NO	OPERATION AND TRUCKING DIRECTIONS	NO. FINISHED GOOD	NO. DEFECTIVE

(Over)

KEEP THIS CARD WITH WORK UNTIL IT IS COMPLETELY FINISHED, THEN SEND IT IMMEDIATELY TO PLANNING DEPT

FIG. 32. CARD FOR IDENTIFICATION AND MOVE ORDER

by the stores department. The chart of Figure 29 furnishes such a picture in concise form. The vertical lines show requirements to take care of orders on hand, these being moved to the right or left as conditions change and the requirements increase or decrease. The horizontal lines indicate whether items are ahead or behind the requirements. The buttons to the right indicate that there is more material in hand than is necessary, while the ones to the left indicate shortages and thus show where attention must be given.

In the stores department there must be complete information regarding the condition of materials and, to furnish an idea of the best method of keeping track of materials, the tops of two inventory records are shown in Figures 30 and 31.

Requisitions on the purchasing department from the stores department and from the Control (or Planning) Department to the Stores Department, along with "Returned Materials" records, are such well known devices and so universally accepted in industry, that the size, color, rulings and wordings are relatively unimportant and only incidental to this discussion and will therefore not be shown.

Movement of material is usually not so well taken care of, and as a suggestion a form of identification slip and move order is offered the reader (Figure 32).

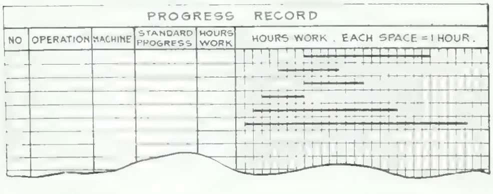


FIG. 33. GRAPHIC REPRESENTATION OF PROGRESS

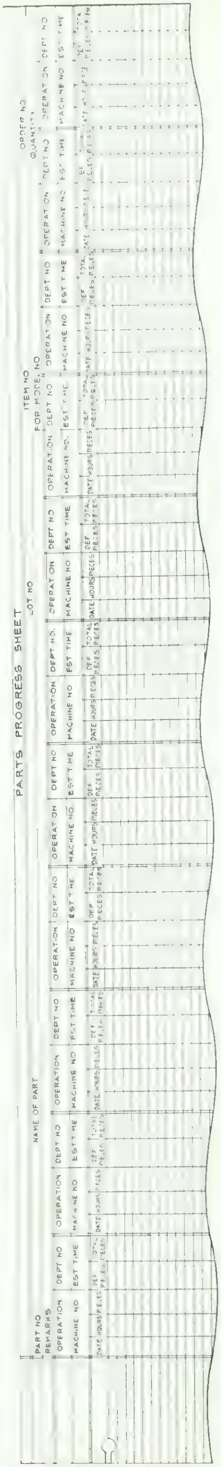

PARTS PROGRESS SHEET
ORDER NO
QUANTITY
ITEM NO
FOR MODEL NO
LOT NO
NAME OF PART
PART NO
REMARKS
OPERATION
DEPT NO
MACHINE NO
EST TIME
DATE
HOURS
PIECES
DEF PIECES
TOTAL PIECES

FIG. 34. PARTS PROGRESS SHEET GIVING CONDITION BY OPERATIONS AND DEPARTMENTS

The foregoing shows how the Control Department works up and follows the flow of parts and operations; how it follows the work of the purchasing and stores departments, and how the movement of material is taken care of, full recognition having been given to the tenth law (materials). The next step to consider is the matter of following shop progress.

On the reverse side of the production order (Figure 23), made out by the Control Department, there should be a graphic progress record, which would show the work to be done, the work done, and the work still to do as per Figure 33, which shows the following:

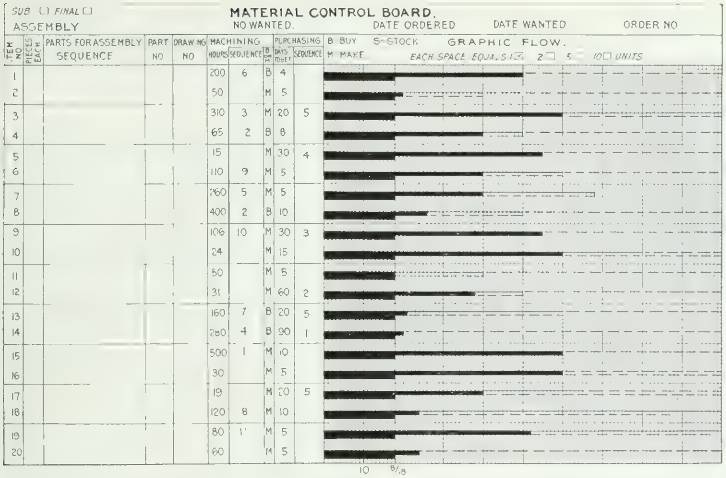
Operation	Hours of work to be done
1	23
2	12
3	15
4	8
5	10
6	27½

Hours of work done	Hours of work to do
8	15
5	7
8	7
3	5
2	17
1	20½

If the value of the visualization must be sacrificed for extreme accuracy, the graphic record can be dispensed with and the "Parts Progress Sheet" (Figure 34) used in its place.

The above outline furnishes a more or less detached presentation of essentials in controlling materials and operations. The question now arises, *Where can we see in one place a coördination of these different elements?* The essential facts we want to keep in mind are:

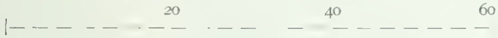
1. Parts purchased or ordered.
2. Parts on hand or received.
3. Parts ordered on the producing departments.
4. Parts furnished in the producing departments.
5. Parts assembled.



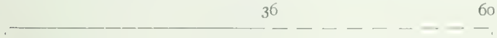
ITEM NO	PIECES EACH	PARTS FOR ASSEMBLY SEQUENCE	PART NO	DRAWING NO	MACHINING HOURS	MACHINING SEQUENCE	B or M	PURCHASING DAYS TO GET	PURCHASING SEQUENCE
1					200	6	B	4	
2					50		M	5	
3					310	3	M	20	5
4					65	2	B	8	
5					15		M	30	4
6					110	9	M	5	
7					260	5	M	5	
8					400	2	B	10	
9					106	10	M	30	3
10					24		M	15	
11					50		M	5	
12					31		M	60	2
13					160	7	B	20	5
14					280	4	B	90	1
15					500	1	M	10	
16					30		M	5	
17					19		M	20	5
18					120	8	M	10	
19					80	11	M	5	
20					60		M	5	

FIG. 35. MATERIAL CONTROL RECORD VISUALIZING FACTS GIVEN IN DIAGRAMS BELOW

Assume that we have ordered 60 pieces of a part, and by drawing a dotted line (two items to the square) we have:

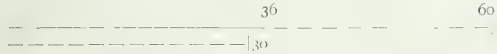


Upon receipt of material we cover the dotted line with a full line for the amount corresponding to the amount received and can show it as:

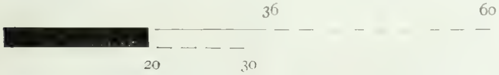


This tells us that 60 pieces were purchased, 36 received, and 24 still to come.

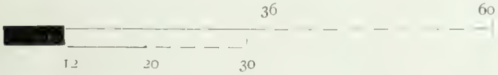
We enter an order on the factory departments for 30 of the 36 received, and can show this fact by a dotted line under the full line as follows:



The departments complete 20 pieces of the 30, and by covering the second dotted line by a full line, we have:



Let us assume further that of the parts completed, 12 are assembled in the finished product and our graph is now as follows:



Showing:

60 pieces	ordered.				
36 "	received,	24	still	to	come.
30 "	ordered,	6	"	"	order.
20 "	completed,	10	"	"	complete.
12 "	assembled,	8	"	"	assemble.

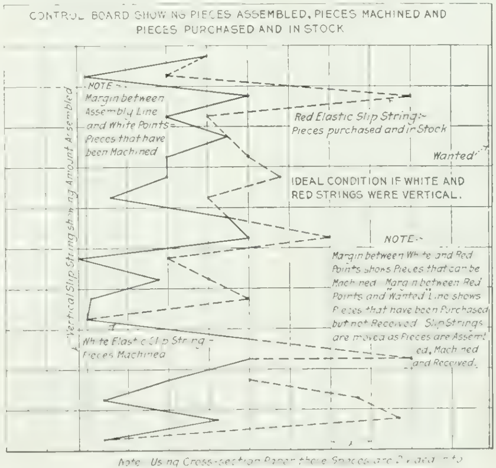
If desired, a color scheme can be shown by using lines as follows, putting one over the other:

Parts purchased—White
" received —Yellow
" ordered —Red
" completed—Blue
" assembled—Black

So much for the method of graphically controlling one part. The problem now becomes one of controlling several related parts, as well as related sub-assemblies. In so doing, this thought must be kept in mind—*a record of what has passed is not particularly important; the record is good only in proportion as it anticipates or forecasts future conditions or likely happenings in time to arrange to prevent both shortages and congestion.*

The "Material Control Record," Figure 35, is a graphical coördination of related units, using the method of graphic lines just described as a basis. It shows sequence as to parts from the standpoint of assembly, machining, and purchasing, and presents a true picture of graphic flow from which considerable can be realized in the way of usable facts. Assume that the purchasing agent, the machine-shop foreman, and the assembly foreman get together and with this sheet make an effort to plan their work in a better manner. The assembly foreman will point out to the others that on parts 2, 8, 11, 13, 14, 18, 20, his margin between what has been assembled and the parts which could be assembled, is so small as not to warrant him in attempting to assemble more units, in fact he could not if he wanted to, as he has assembled all of part 11 that has been machined.

This puts it up to the machine foreman, who in looking over the sheet finds that while he has parts in order covering items 2, 8, 11, 13, 18, with materials to work on and can therefore get behind these items, he has only enough parts on items 14 and 20 for two and six units, respectively. The purchasing agent, in looking over the sheets, finds that he must get busy as material is all in for only four parts—3, 16, 18, 19—and that



Note Using Cross-section Paper these Spaces are Divided into Tenths, each Tenth [illegible]

FIG. 36. CONTROL BOARD FOR SHOWING CONDITION OF ORDER

material for 14 and 20 is urgently needed, as well as on parts 1, 5, 9, 15, as all the material on hand has been machined.

In other words, the graph enables one to pick out the points where pressure should be exerted. The eye catches the exceptions, and as there are 20 items to a sheet, much ground can be covered rapidly.

Sub-assemblies can also be listed on a separate sheet, the vertical line indicating final erection.

The above presentation has treated with manufacturing where there are many parts to a model or unit. In cases where products are turned out having a few parts, control boards (Figure 36) can be used to advantage. The chart illustrating the board is self-explanatory.

A close study of the foregoing will show that we have recognized the following laws in describing the methods graphically controlling materials and operations:

2. Scope of control.
3. Draw versus push.
4. Requirements.
6. Importance and availability.
7. Operations.
10. Materials.

In the next paper, consideration will be given to labor and equipment control, leaving it for the concluding chapter to coördinate the control mechanisms.

(*To be continued.*)

* * * *

Accounting

By B. L. Van Schaick

Industrial Engineer, Wright-Martin Aircraft Corporation

A RECENT industrial problem was to maintain an accurate materials record and follow-up on a vast number of widely varying manufactured parts in such a manner that the records should possess a maximum amount of detail and yet be capable of being operated with a minimum of delay and effort. The mechanical equipment installed for the solution of this problem consisted of multi-color presses and Powers sorters, punches, tabulators and recorders.

Three distinct colors of standard tabulating cards were used for each separate piece of material. As soon as a purchase order was placed a set of cards was printed for each separate item or piece, using a linotype slug set in a multi-color press. This slug printed the name, part number, erection position and sequence symbol, weight, size and assigned location in stores, etc. on the top margin of the cards.

This same information was next punched into the cards and the record shown by the punched marks was carefully checked to insure its accuracy. The printing attachment of the Powers equipment was lettered so that lettered symbols could be printed as required by substituting letters for figures in some of the columns.

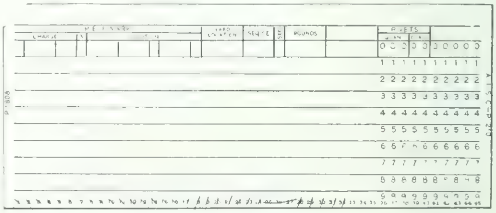
These three cards were then filed, one by type of material, the second by vendor's name and the third as a tickler memorandum by date. The cards were handled in the same manner as in a cross index reference file except that twice a month a "lag" report (by class of material and vendor's name) was printed by passing through the Powers listing machine the cards indicated by the tickler file.

During the time that the goods were in transit between vendor and purchaser the record was maintained by removing from the vendor's file the cards representing all material shipped, and refiling them by transportation company and file number in the "transit file." As the material arrived at its destination the files were broken up. One set was sent to the stores department to take its place as a perpetual inventory card; the second formed a central master control in a "materials control division"; the third was sent to the "materials clerk" at the point of usage to be filed by erection sequence and part number.

At the Point of Usage

As soon as a batch of material cards was delivered to the materials clerk at the point of usage they were passed through the listing machine and a list printed to show the material available. This list was sent to the local superintendent of erection (or to the general foreman) as to information as to just what material was available in storage. Based upon this available list the erection executive instructed the materials clerk as to just what material was required from stores. The materials clerk then proceeded to pass the proper cards through the listing machine again to print "requisition on stores" for the material required. The cards were then filed by part number in a requisition file.

On receipt of the requisition the stores department removed the cards from the inventory file and printed from them (on the listing machine) a charge slip for the material delivered. This slip was sent to the accounting department and to the materials control department. The cards were then filed in the stores department as evidence in a materials delivered file.



GREEN CARD FOR RECORDING MANUFACTURED MATERIAL

When the material arrived at the requisition point, and as it was erected into the job, a report thereof was made to the materials clerk. The proper cards were then removed from the requisition file and a lister printed from them a "materials used report" which went to the accounting department and also to the materials control department. The requisition file became the control between materials requisitioned and materials actually used.

A master control file followed these same general steps so that at any time by passing cards through the listing machines reports on material available, material in process of erection, or material actually accepted in erection can be promptly supplied. These files can also be called upon from time to time to supply special information as total merchandise supplied by any vendor. All that is necessary is to run the cards through the sorting and listing machine.

The System Is Very Flexible

The listing machine can be made to give two copies at one operation by using a sheet of carbon paper. Any number of copies may be secured by passing cards through the lister a second, third or more times.

It will be noted that all the cards are approved, read and checked immediately after being punched. All subsequent reports are made mechanically so that the number of clerks necessary and the liability of error are reduced to a minimum. The clerical force involved is of a cheaper grade than would be required if hand instead of mechanical methods were followed.

Need of Adequate Specifications for Well Known Materials

By Walter S. Timmis

Consulting Engineer

THERE is probably no branch of engineering so neglected as the preparation of adequate, inclusive, common sense specifications.

This is as true for well known materials, such as, valves, shafting, transmission machinery, leather and rubber belting, pipe and fittings, electrical supplies, steam specialties, etc., as it is of larger apparatus such as boilers, engines and generators.

The common method of specifying a particular make "or equal" is a weak attempt to set up a standard of comparison, but in many cases it seems to be the best devised so far. This custom has grown generally on account of the lack of suitable standards and to the superior advertising done by the manufacturer of the specified article.

Frequently two or three makes are specified when it is definitely known that there is a wide difference in grade as well as price.

Catalog Information

The source of information from which most specifications are prepared is the manufacturer's catalog; some of these contain specific information as to material, construction and performance, but many of them are lacking in essential details of needed characteristics. Many catalogs which actually contain definite characteristic information are so poorly edited that it is necessary to wade through hundreds of pages to get a clean cut statement in abridged form.

Technical information should be separated from advertising talks; vendors would be well repaid for supplying full technical data.

The manufacturers of belting, leather, canvas and rubber, might give very definite information; in the case of leather, the various parts of hide used, tanning process, average weight, thickness and tensile strength. For canvas belts, the details of construction and material in cross section, tensile strength per inch of width, character of filler, number of strands per inch of width and other characteristics of a definite kind and capable of being specified should be stated. Such information might be tabulated for different grades and widths and thicknesses of belt.

The same is true of rubber covered belting and the various grades of belting recommended for use in places where certain kinds of acids are being used.

Standards

The American Society of Mechanical Engineers has rendered a splendid service in issuing a code for standard boiler construction. The American Society of Testing Materials has established standards on cement and other materials.

The Bureau of Standards would render a signal service to the country, productive of great national economy, if minimum requirements were established on various grades of a large number of materials easily capable of such classification and standardization. Such materials as are not susceptible of analysis by the purchaser should first be standardized and graded.

If it were possible to specify rubber covered belting as U. S. S. No. 25 or 26, or feed water heater as per U. S. S. No. 92, or low pressure gate valves as per U. S. S. No. 107, much time, effort and money would be saved.

As before stated, numerous standards already exist, having been made by the technical societies, boards of fire underwriters, Navy Department, etc., but a radical extension of such standards brought under the United States Bureau of Standards would effect great economies, would save the honest manufacturer from unfair competition, and would not stifle progress in initiative, quality or design.

Preparation of Specifications

Years of study are required in preparation for writing non-ambiguous, sensible, workable specifications.

Handbooks, catalogs, personal note books and a well kept file of magazine articles are necessary for reference, but a keen sense of discrimination and good judgment, together with an intimate knowledge of requirements are absolute essentials.

The successful man in this field has the faculty of compiling memoranda wherever found and has it available at the time of use. Specifications are nearly always written hurriedly, because they are usually prepared after all else is done, and, coming at the end of preparatory work, are regarded only as a necessary evil.

Statements in specifiations should be concise, incapable of misinterpretation, should call for attainable standards of performance, for merchantable materials, and be written in merchantable terms.

Guarantees should be rational and terms of payment as liberal as will secure protection to both parties.

The specification indexes published for architectural and engineering work are rendering good service in this field.

Recommendations

1. That specification preparation be given a place of distinction in the colleges and in the engineer's office.

2. That a specification data file be kept, properly segregated in classes, sub-classes and individual subject. That every scrap of information of value relating to this subject be gathered and made available for use.

3. That statement of specifications be concise and free from ambiguity. The preamble of specifications to give general description in broad terms. Never in any case call for special design when stock design will fill requirements. Unreasonable specifications cost clients money and engineers their reputation.

4. Consider the vendor as well as the purchaser. Good business can only result from fair treatment.

5. Call for attainable and reasonable guarantees only. Others cannot and will not be lived up to.

6. That the United States Bureau of Standards issue a list of established standards of the various technical societies including the Mechanical, Civil, Electrical, Chemical, Heating and Ventilating and other engineering societies, in pamphlet form.

7. That the Bureau of Standards prepare specifications, and establish numbered standards of one or more grades of various manufactured materials used in engineering work, such as belting; packing; hose; pipe and fittings for water, steam, acids, ammonia and other substances; valves, high and low pressure, steam and water; globe, gate, angle and check; blow-off and safety; steam and return traps; feed water heaters; steam separators; boilers for power, heating, steam and hot water.

8. That the United States Bureau of Standards call on the various technical societies to submit standard specifications on all materials capable of standardization and have them reviewed by a United States standardization committee and if satisfactory, adopted.

How the United States Government Saves War Plants from Damage

By Edmund Leigh

Manufacturers may not appreciate the great importance of the service rendered to them by the Plant Protection Section of the Military Intelligence Branch of the War Department. This section guards industrial buildings and war material by preventing fires, installs protective systems and apprehends aliens, builds non-climbable fences around plants, erects protective lighting systems, and prevents sabotage.

Mr. Edmund Leigh *writes as an authority on the above subject. He is executive director of the Plant Protection Section of the United States Military Intelligence Branch, at Washington, D. C.*

THE Government's crying need in these crucial days is for goods and materials, crude and in the finished state, for munitions of war of every kind. Of equal necessity with the goods themselves is the demand that they should be delivered on time. As time is the essence of all war contracts, it is necessary that the Government shall not fail in its endeavors to supply our army, to build our ships, to clothe our soldiers, to feed them, to give them guns, cartridges and bullets, and cannon, great and small.

These preparations are all so co-related that they must work with machine-like precision. Delay is the missing cog in the masterwheel that throws out every calculation.

So vital to the Government is this necessity that as a war measure, under the Military Intelligence Branch of the War Department, has been established a Section of Plant Protection.

Last year 240 grain fires destroyed flour enough to make more than a half-billion loaves of bread for the army. Large quantities of material awaiting shipment to the Allies, not only of food but of ammunition, explosives, guns, clothing, machinery and other supplies essential for winning the war were also destroyed.

WORK OF THE PLANT PROTECTION SECTION

The work carried out by the Plant Protection Section is of supreme importance at the present time. No amount of productive activities will avail, if warehouses full of necessary supplies are to be allowed to burn down through carelessness, or to be blown up by enemies in our midst. The work undertaken by the Plant Protection Section embraces the safeguarding of every Government activity in every state in the Union, and ranges from the protection of a powder plant against explosion, to the placing of lights around the grounds of an aeroplane field. It even goes into the details of the employment of men and women in Government factories throughout the country, and the protection of numerous plants against alien enemies and sabotage.

Of course, most of the methods for combating the machinations of enemies within cannot be disclosed in a magazine article, but a general idea of the operations of the Plant Protection Section may be given with a view to better acquainting plant owners with an important activity of the Government designed especially for their protection.

PROTECTION AGAINST FIRES

To treat of fire dangers first, it must be stated that simple carelessness is recognized by experts to be responsible for not less than 75 per cent. of our fires.

It is remarkable what little things will lead to fires: For instance, in a big factory, you will be surprised to be told that everything depends on the condition of the floors, especially if they are of wood. If the floors are oil soaked, if cuttings from clothing, waste paper, or light inflammable materials are left carelessly on these floors, the chances are that the factory will catch on fire from the sparking of motors on the floor near these waste materials. Or the throwing down of a lighted cigarette, the use of a blow torch by a machanic making repairs, or a plumber using his soldering iron may start a floor fire. We are trying to make people in factories keep their floors absolutely clean. There is no reason why they should become oil-soaked if drip pans are put under machinery where they are required; there is no reason why clippings and such things should not be swept up every hour or so and placed in metal lined bins with close fitting tops, or in metal waste cans with lids.

Some of the biggest fires in our factories have started from that very mysterious thing called "spontaneous combustion." A fire will break out in some unknown, obscure corner, or clothes cupboard, or under a stairway. Oily rags have little air spaces in them and, of course, these spaces are filled with oxygen. When they are thrown into a close, warm place, these rags become overheated and the oxygen in the air spaces helps them to catch on fire by themselves. The remedy to combat such a condition is simple: It is not to throw oily rags nor to leave oily waste in obscure holes and corners, and not to use such places for storage purposes at all.

A very prolific source of fire-danger in factories is the electric wiring. Electric wires that are not properly installed or properly insulated can cause a larger and more extensive fire than almost any other source of danger. If badly insulated wires are run through or behind the walls of buildings, passed in and out among partitions, under the floors, and through the ceiling, and if these wires become overcharged, or if they are injured by people driving nails through the floors or through the partitions where the wires are located, there will a "short circuit" followed by fire, or else the wires will become overheated and begin to glow, and so set fire to whatever is in their immediate neighborhood. Buildings have been set on fire by electric wires at four or five different places all at the same time, and the thing has looked so suspicious that everybody jumped at the conclusion that alien enemies were at work.

SMOKING CAUSES MANY FIRES

One of the gravest causes of fires in this country is the habit of smoking and throwing away lighted cigarettes, cigars and matches. Take for instance a smoker who throws away his cigarette while passing some factory. He may drop it on the sidewalk and it may fall through a grating into the basement, and in this place there may be accumulations of dust and paper. There will soon be a cellar fire in that factory and cellar fires are notoriously the worst kind to fight. The reason cellar fires are so bad is because the place becomes filled with dense smoke, there is no ventilation and usually a cellar is divided up by partitions, etc., which prevent the water from reaching the blaze. Furthermore, from the cellar in all buildings there are usually ventilating shafts, elevator shafts and other openings leading upward into the building itself. They act as flues and draw the flames and, before you know it, the whole place is ablaze.

All these openings leading from the cellar upward into the rest of the building should be blocked off by fire doors and by enclosing these openings with fireproofed material, such as tiling, sheet metal, wire glass and other things that will stop fires. Small elevator, and other shafts are often the cause of the destruction of buildings because people throw things down these shafts. Consequently, a big pile of waste paper and other rubbish will accumulate at the base of the shaft and the fire takes place.

Boiler Room Hazards

Another source of common danger is the heating plant and the chimney stack. Very often heating plants are improperly installed, the boiler room is not shut off from the rest of the building, the steam-pipes run too close to the woodwork and inflammable materials such as excelsior, kindling wood, and various kinds of waste. Often lubricating oils are left in the boiler room and form an easy material in which to start fires. If the boiler room had fireproof doors the fire would be confined to this room, but, half the time, these doors are left open or do not exist, and the fires spread from the boiler room to the rest of the building.

Chimney flues leading from furnaces are often improperly lined with fireproof material, and sometimes big beams and furring strips will pass into the chimney and be located too near the hot surface. There is a rather curious thing about fires that start in or near chimney flues. The actual flames from the chimney need not reach surrounding woodwork at all, but the wood will become what is known as "carbonized," that is, all the water will be abstracted and it will be raised to a high kindling point, so that it will catch on fire much quicker than ordinary wood. The consequence is that when a supply of oxygen reaches this heated, carbonized wood from a hot draft or something like that, the wood will burst into flame spontaneously.

Another common locality for fires is the lofts and space just under the roof. It is customary to fill these places with junk of every description which is often highly inflammable. This material becomes overheated, being so close to the roof, and it does not take much to start a fire there; fires under roofs, by the way, are most difficult to fight because they are far from the water supply and usually in a corner where they cannot be reached.

Inspection of Plants Making War Material

It is the business of the Plant Protection Section to inspect all plants throughout the country making war material. Every factory that produces anything for the Army is thoroughly inspected and every possible consideration is given to matters which might cause fires. They are really innumerable. Some factories, such as ammunition plants and powder magazines, require expert skill in their inspection; aeroplane factories use quantities of lacquer and other liquids known as "dope," which would be serious causes of fire if inspectors did not give them due consideration. There are also oil plants and chemical plants that require special attention. Oil and chemical fires cannot be fought by water, and we have to devise special means for putting out such fires by using hot steam jets, lime, sand, solutions of sulphuric acid, glue and soap, and other substances.

Protection for Powder Plants

In powder plants, Plant Protection engineers have to devise mechanical means for fighting fires so that water can be thrown on the burning structure by means of valves located outside the buildings. These valves can be pulled or operated even while a man is running away from a building full of powder.

Our inspectors have to consider such matters as building construction, water supply, power, electricity, sprinkler systems, and other problems too technical to mention in a general article. Never-the-less, they take much engineers' study, and often require the expenditure of large sums of money.

Guarding Against Enemies

There is another phase of our work quite different from that here described, and yet it is highly important also. This is the guarding of plants from the acts of alien enemies and others who may wish to stop production in the United States in the interest of Germany. There is a lot of this kind of work going on in the United States today and probably it will increase as Germany's condition becomes more and more desperate. It cannot be revealed how we guard plants from alien enemies, but the Plant Protection Section is "on the job" and is doing everything possible to prevent plotters from succeeding in their attempts.

Lighting and Fencing the Grounds of Plants

Another important section of our work connected with this guarding scheme is the lighting of the grounds of plants and the lighting of the plants themselves with electric flood lights and search lights so that people cannot approach these plants to do damage without being seen. This lighting scheme as a means of guardianship is one of the most modern problems. You all know that years ago banks used to be guarded by watchmen. Now they have done away with a lot of watchmen and they leave banks brilliantly lighted at night so that people passing on the outside can see all that is occurring within. Where the grounds of a plant are well lighted, the dangers from approach by unauthorized persons are reduced. Protective lighting is another part of Plant Protection work.

.Plant Protection also plans and recommends fencing around plants. There are fences and fences. Anybody can climb an ordinary fence but we have to put up a fence that you cannot climb over. Some of these fences are 8 to 10 feet high. We make them unclimbable by having the wires run in a peculiar manner we put barb wire at the top so even should the fence be climbed it will not be easy to "go over the top." There are also schemes for charging these fences with electricity in such a way that it makes it very awkward and even dangerous for a person who tries to climb them.

Employment and Labor Maintenance

A Special Department to Aid Employment Executives

Standardizing Labor Turnover

By Harry W. Kimball

THE recent symposium in INDUSTRIAL MANAGEMENT upon labor turnover revealed considerable variation in the way terms were used and a lack of uniformity in methods of calculation. Until terms and methods are standardized no accurate comparisons of different plants can be made. A reading of the different contributions shows that three factors are considered to enter into labor turnover. Some of the contributors in determining labor turnover take into account only one of these factors, others make use of two, a few all three. The factors are these:

1. *Plant change.* Plant change is the increase or decrease in the total number of the working force due to conditions which require more or fewer employees.
2. *Labor replacement.* Labor replacement is the number of employees lost for any reason who must be replaced to maintain the normal working force.
3. *Labor variation.* Labor variation is the change from day to day in the number of persons actually working as compared with the number carried on the payroll.

The theoretical ideal for any plant is a stable working force; work for all, all the year; and all the workers at work all the year. Any variation from this ideal condition constitutes what perhaps may best be called *personal fluctuation.*

One factor in this fluctuation is plant change. Seasonal work may cause a number of employees to be laid off for a longer or shorter time. Increased orders at certain seasons may demand that the working force be increased. Possibly the adoption of new efficiency methods may reduce permanently the working force. New additions to the plant may permanently increase it. Now if in calculating labor turnover the number of laborers hired is used as a factor, then any increase in the permanent number of workers will mean a large labor turnover; and if the number of laborers leaving is used as a factor any permanent decrease in the number of workers will also produce the same result.

The fact is that plant change is a distinct element in the personnel fluctuation of any industry, and should be separated from the other two elements, labor replacement and labor variation. Plant change is affected by the results of the sales force and by production methods, and is not a part of labor turnover as that term has been commonly used.

LABOR TURNOVER OR LABOR REPLACEMENT

What most persons mean by labor turnover is labor replacement. The term labor turnover arose in connection with discussions of the cost of hiring and firing workers. It was recognized that men drifted in and drifted out of industries. Competent men often did not stay, and incompetent men had to be fired after expensive trial. Effective labor service finds the right man for the right job and then gets him to stick. If he does not stick then someone else has to be hired to take his place, or if a mistake in judgment is made and an unfit person employed then that person has to be fired and another worker found for his job. This is labor turnover but a better and more accurate phrase is to think of it as necessary *labor replacement.*

The National Employment Managers' conference by deciding that the number of employees actually working each day rather than the number appearing upon the payroll should be the proper base for computing labor turnover introduced another factor into personnel fluctuation. This factor, which may be termed *labor variation,* is something different from either plant change or labor replacement.

The number of the working force actually working on any one day is dependent upon sickness and accident, upon unexplainable absences, and upon habitual loafing usually after pay day. Increasingly, employment offices are keeping records of these daily absences, seeking for the causes of these constant leaks and endeavoring to stop them. But such absences do not mean usually that a man is fired or even that some one is hired to take his place. This labor variation is not labor turnover as the term is ordinarily used. Yet if the daily working force rather than the payroll sheets are used as the base for figuring labor turnover then this element of temporary absences affects to some degree the percentages.

LEAVINGS VERSUS HIRINGS

The National Employment Managers' conference also decided that leavings rather than hirings should be the determining factor in calculating labor turnover. The reason for this is that labor turnover is change in the working force and all leavings necessarily make change, whereas hirings might be either change or increase. If a plant has a working force of 1,000, and from that as a base labor turnover is calculated, then all leavings mean change in the working force even though the working force may be permanently decreased. If the working force be increased still it will always be true that all leavings represent change, and this is the real factor in labor turnover. But it is also evident that if you divide scientifically the personnel fluctuation into its elements, and consider your labor turnover as the equivalent of labor replacement it will make no difference whether hirings or leavings are used as the factor, because they will be the same. This may not be true of any one weeks' calculation, because it may happen that some persons leave whose places may not have been filled in the same week, but it will be true of any labor replacement considered for the period of a month or a year.

SUGGESTED NOMENCLATURE

In view of these facts I would suggest the following nomenclature:

Personnel Fluctuation
Plant Change
Labor Replacement
Labor Variation

A report then of personnel fluctuation for any period of time should show in percentages the plant change, the labor replacement and the labor variation. These are three distinct elements in the personnel fluctuation. They are due to different causes, require different remedies and should never be confused.

One other subdivision may be desirable. Persons whose places must be refilled leave for avoidable and unavoidable reasons. Among the unavoidable reasons are marriage, death, ill health, retirement, family leaving city, and military service. It is worth while to divide the leavings under labor replacement into avoidable and unavoidable, making separate percentages. The decrease of the avoidable leavings from week to week, and from year to year, is the true measure of the efficiency of the labor service.

While a record should be kept of all transfers from one department to another within the plant, these transfers should not enter into the calculation of any personnnel fluctuation as they do not increase or decrease the working force.

The simplest way of calculating these three elements of personnel fluctuation is by the week, and the simplest base to use is the number on the payroll.

RULES FOR CHANGE, REPLACEMENT AND VARIATION

Plant change would then be determined by the following rule: Divide the plant increase or decrease for the week, as the case may be, by the total number on the payroll at the end of the week.

Labor replacement would be determined by dividing the total number of those leaving, less the number of those leaving who may have been laid off because of lack of work, by the total number on the payroll at the beginning of the week.

Labor variation would be determined by subtracting for each day of the week the actual number of the working force from the number on the payroll for that day; then find the average number of absentees for the week and divide this by the average number on the payroll for the same time.

It is difficult to adapt any one system of tabulation to different plants, especially in the changing conditions of war activity, but the fact I would emphasize is that any accurate consideration of personnel fluctuation must differentiate clearly between plant change, labor replacement and labor variation.

* * * *

The Successful Employment Department

By Russell Waldo

OF all articles presented to men in industry none should, in my opinion, command more space or consideration than those dealing with the employment department. It is the staff of workers of this division that has most to do with the efficient working of the plant.

There are many elements that go to make up a successful labor department. They deserve first place in consideration, for methods and practices which are found to exist in the actual workings of the organizations of today should be discarded for easier and more economical ways and means.

The principal drawback of the new and more efficient idea usually rests with the man who has the authority to put it into use. He does not grasp the idea, does not know the greater benefit to be derived from it, has heard no one discuss it and has been unable to read upon the subject so as to understand it. It is surprising how many such men who do not know are unwilling to be caught learning the actual working principles of the modern methods. Some are almost ashamed if they are detected educating themselves. The man who makes the best department head regardless of his position is the one who is always open to argument, is always ready to consider and learn the actual workings of a new idea, who has the advancement of every man under him continually before him, and who tries to promote or make the way easier for each of them.

REQUIREMENTS OF A SUCCESSFUL EMPLOYEE

The first question that arises in my mind regarding selecting men for promotion is this: Is the average man with all his faults and drawbacks the proper man to be given the responsible position in a progressive organization? After making a careful study of the average employee I am almost compelled to declare against careful selection.

I have in my notebook details of many men who are holding responsible positions who apparently have not the first elements that make up the employee who could efficiently do the work. They were selected by the guess method, with little or no thought of personal aptitude or the requirements of an efficient employee on certain work.

I actually believe some firms in this day of rapid commercial advancement select the employee who wants the job if the boss likes him, regardless of whether he possesses qualifications or not. It would be absurd to give a man a place as blacksmith who had succeeded as a jewelry maker, or to select a man for heavy machine repairing who had proved successful as a phonograph or watch repairman. Each type of man is successful because of the size of the material he works on. A successful jewelry salesman usually makes the worst kind of furnace salesman. It is this way in all classes of work. Some men will succeed around the small machine, while others will do their best upon the largest.

In considering a man for a responsible position there is no element concerning the man's makeup which the employment manager does not need to bring into consideration. Each has a direct bearing upon the man's chance of success. The combined elements which constitute the man and make him what he is must have careful consideration.

A FEW IMPORTANT FUNDAMENTALS

In selecting the employee the interviewer strives to pick the man who studies and profits by what he sees. All progressive organizations are beginning to realize the value of study in measuring a man's future value. What effort of a man will win for him greater respect from a firm than study? Study is the very foundation of success. No man ever succeeded who did not study in some form or another. The progressive employment department is placing more stress upon this element now than ever before. This is because the eager strife for supremacy in the commercial world today is gathering every man who holds out any determination to study.

Many corporations are finding it profitable to establish schools in which they instruct their employees. This pays unbelievable dividends upon the cost. It was the progressive employment department that first found the need of the school and, since the first one was established many years ago, every firm as it rises now is establishing schools. Many have been established within the last few months upon the success that has been gained from others.

The best employee is the one who enjoys studying. I do not mean by this the one who studies in a haphazard method. He should lay out or have laid out for him a definite plan of study. This he should follow to the letter.

The greatest incentive for study is always offered in the subject in which the student is interested. This often is not the field which he is working in, although he enjoys preparing himself for the thing that he intends to follow. This is usually reaction from the work which he follows during the day. A young man studying in a field different from his work looks forward to his evening hours when he might relax his mind to his favorite study. The progressive employment department today is encouraging every man to study something and eagerly searches among men who prepare themselves for something demanding greater responsibility.

I have noted one young man in particular. He possessed an abnormal amount of ambition to climb. To realize his ambition he sought connection with a firm that advertised among their employees as one that demanded of every man preparation for something better. They wanted young men who would come in and make good. They wanted men with originality, those who could look ahead and show the company where they might save money or improve efficiency.

This fellow succeeded in obtaining the place he asked for and at once began a study of the inefficiency of the plant. He found the root of the evil in less than a week and at once began to plan a method by which he could overcome it. He worked hard, studying late every night to and from work on the car, and sometimes in slack moments during the day.

I saw the suggestions that he had ready to present to the management by which they could save thousands of dollars every year. They were good and showed an extraordinary amount of skill and insight on the part of the young man.

He promptly made out a suggested program, setting forth the objects of his plan and the results that he sought to obtain. These were in no way descriptive of the workings of his plan. This rough outline he presented to the employment manager of the organization. Later he presented it to the assistant general manager for his consideration. He was called into a conference upon his plan although the matter was never carried any further.

Today this corporation is still working under the old plan, losing valuable men every day, seeking outside men for the more responsible positions and rejecting the plan that would have saved them a huge sum each year.

This occurred in an organization having many of the latest ideas: An efficiency manager, standardization engineer, welfare worker, grocery, dining room, employees' magazine, employees' school and other features.

This is an exceptional instance and should not be interpreted as applying to the firm which is striving to become efficient. It is mentioned for the sole purpose of awakening the organization that considers itself efficient although in reality it is pseudo efficient.

The progressive employment manager could have put into operation a plan that would have saved the organization enough energy, now being wasted, to have done nearly half of the work.

Value of Contentment

A man to succeed must be contented in his work. This element is controlled by love of work, environment and sufficient remuneration from his labor to allow for the necessities of life. The bearing which these elements have had upon his life in the past should be carefully considered. The future can and should be favorably controlled.

Contentment has much to do with coöperation. Without contentment there can be no coöperation in any corporation.

Coöperation in any industry is the prerequisite of its success. No type of a corporation can expect to succeed without the wholehearted coöperation of each and every employee from the office boy to the general manager, or from the superintendent down to the sweeper.

If properly aimed at by those in charge of the various departments and the executives it is the easiest factor of all to obtain. It is an easy thing to gain, although a hard thing to regain once it is lost.

Much of the coöperation is gained or lost by the department heads. They breathe the spirit of the organization into the employees. When corporations realize the influence department heads have over those in their department, greater care will be exercised in the selection of the men to be responsible for the handling of other men.

Gaining Cöoperation

The successful leading of men, creating within them the desire to climb, assuring them of a reward for their perseverance, these are the predominant elements bringing about greater coöperation. Lacking any one will lessen the final result in the plant.

Coöperation cannot be had from the average man until he has been assured some sort of compensation for his endeavors. Very few in the production department realize that the greater their productive value to the firm the greater their success.

These elements are the ones that demand the most careful consideration of the employment department, and are those that will decide the success or failure of the organization of today.

* * * *

Safeguard Working Women and Their Offspring

By Alice S. Cutler, M. D.

A WELL known labor leader in an address given to a group of women, who took the government preliminary factory employment manager's course in Cleveland, Ohio, this last summer, said, that when they were prepared to accept positions in different parts of the country most of them would have to work "for blood money." Why are union men so opposed to women going into factories? Corporations claim that the unions do not want women in factories for fear there will not be enough work for men to do if women are to be employed in increasing numbers. Now part of that statement is true, but to come nearer the truth, I must say that we cannot "pull the wool" over the public's eyes any longer, for this question of "women's versus men's labor" goes very deep, so deep that working men are unknowingly fighting for the biggest thing in the world—their future progeny. Only, they are unable to express it in so many words, but as a mass they are unconsciously fighting the instinct of self preservation, and fighting hard.

I have been asked over and over again, why I was willing to leave a good position in a large hospital to go into work where I would have to come in contact with many unpleasant things. As a physician, coming in contact with many working women, I have always wanted to get first hand knowledge of working conditions in a factory. That chance came to me this summer.

From conditions that existed in the factory where I worked, and from information obtained from my colleagues, who too worked in factories, I was impressed more than ever of the relative value of making compulsory, the physical examinations of women workers, and then giving them work according to their physical limitations and strength. It has been demonstrated to the whole world, from authentic information received from England, that it was because of her "sins of omission" at the beginning of the war regarding her women; such as the lack of physical examinations and proper placing in factories that many women have been made physical wrecks.

During this last year, New York State started "prenatal clinics" where a woman can go and have the best medical advice during the whole term of pregnancy, with the idea of helping to make labor easy, and for the protection of the child. This is a splendid innovation, but to be consistent we must go back to the time that a girl starts in to work, and consider her physical endowments and special functions, which make the protection of her health even more necessary than the protection of a man's health. This country cannot afford to have "sins of omission" laid at our doors.

From the outlook of public health we must have women supervise women, and the best reason for insisting that a woman worker be examined by a woman instead of a man is, that being a woman herself, she can strike at the root of evils that are powerful in undermining a working woman's health. Especially in factories hiring foreign women, better results are obtained by having a woman examiner give them their physical examinations, as this type of worker talks freer to women than to men, due to racial traditions of what constitutes modesty.

The labor situation both now and after the war will, of course, be critical. Washington advices state that there is now a shortage of 1,000,000 men in the labor ranks. This situation can only be met by recruiting women for work. It is being made apparent each day to all of us that large numbers of men are rejected for active service because they are not physically fit. Knowing this to be true, what must be the ratio of unfit women? How many concerns have their women workers examined before allowing them to work? Very, very few, unfortunately. Will we allow industry to make a "mess" of our womens' lives on the plea of war necessity?

* * * *

Improving Telephone Service

By A. Vere Shaw

With the United Shoe Machinery Corporation

IT is so easy to fall into bad habits in connection with anything that is a matter of hourly use, that oftentimes we fail to appreciate the difference between good and poor telephone service. A few months ago this matter came forcibly to our attention and as a result we worked out a series of bulletins—10 in all—aimed to improve the telephone service in our own building, in connection with our branch offices, several of which are connected by private wire, and for the benefit of our customers.

Thinking that our experience may be of benefit to others, several of the bulletins are reproduced herewith: Bulletin 1 outlines the entire plan except for some improvements that were made in the operation of our switchboards. The result of this educational effort has been a material improvement in the telephone habits of our entire organization.

The bulletins below are 1, 3, 4, 6 and 10. Those omitted are: bulletin 2, General Information; 5, How to make a Local Call; 7, Toll and Branch Calls,; 8, Courtesy; number 9, Miscellaneous.

BULLETIN NO. 1

A certain man recently hung up his receiver, after a telephone conversation, and said to a friend at his side: "I have never met that young man face to face, but the way he talks over the telephone is typical of the whole organization of that house. They always answer every question in a polite and courteous manner. They never keep you waiting unnecessarily. They all seem to take a personal interest in what you have to say and you can be sure that your telephone requests will have the most careful attention."

The telephone today is one of the most important tools of business. Your success in life will depend mostly on the way you handle your tools. For your sake, therefore, and for the sake of the Corporation—whose success you and your fellow-workers make possible—are you willing to make a brief study of the telephone? With your help, this organization can soon win an enviable reputation for business like telephoning.

Do not be misled as to motives. You are to go into this for what you personally can get out of it. The Corporation expects to foot the bill with a view to its own gain. Our objects, however—personal or corporate—are inseparably bound up together. Your gain is our gain.

First lesson on the Art of Telephoning will be sent out Monday, June 10, and a new lesson will follow every few days. Lessons are to be read and their teachings put into practice immediately. Contrary to the usual procedure, you will be assumed to have a perfect grade in your lesson until you are caught by your associates, or the operators, in the act of disregarding instructions. Please report direct to the guilty person any infractions you observe and notify him or her to review carefully the proper lesson. Keep your lessons for future reference.

There is nothing like the old reliable Oil of Good Will to make the machinery of business run smoothly. First lesson, Monday, June 10!

BULLETIN NO. 3. HOW, WHEN AND WHERE TO ANSWER THE TELEPHONE

Do you know that 95 per cent. of the people doing business with this Corporation call over the telephone? Sort of worth while to dress up our telephone entrance, then, and make those who enter by the telephone door feel at home as quickly as possible—isn't it?

Your success with this Corporation, or anywhere, depends on your personal efficiency. The success of the Corporation depends on the personal efficiency of all its workers. Your personal efficiency, therefore, is of considerable importance to both of us.

HOW TO ANSWER:

1. When answering a call for your Department, say "Sales Department," "Eyelet Department," and not "Hello."
2. When you answer for the Department and have direct dealings with the public, and your line is more or less individual, give your department and your own name—thus, "Sales Department, Mr. Gay talking."
3. If the line is used almost exclusively by you, give your name—thus, "Mr. Green talking."
4. Answer for an official, in his office—thus, "Mr. Underwood's office."

NOTE: Ascertain at once which method you should use and begin with the first call you answer.
"Hello" is fast becoming obsolete.

WHEN TO ANSWER: WHEN THE FIRST BELL RINGS!

Delay in answering

(1.) Wastes the time of the caller.
(2.) Wastes the time of two or more operators.
(3.) Needlessly ties up miles of wires and costly equipment.
(4.) Causes repeated rings, distracting the attention of those around, making them pause in their work and even take useless steps toward the telephone.
(5.) Is mighty inconsiderate and unbusinesslike.

WHERE TO ANSWER: Speak into the transmitter—your mouth two inches away.

START RIGHT—ON THE NEXT CALL

BULLETIN NO. 4, SIGNALING THE OPERATOR

Take out your watch, or borrow one. Hold it up to your ear:—

"Ticktickticktickticktickticktickticktick."

Put the watch in your pocket.

Do you remember how the dignified, time-worn grandfather clock that stood in the hall of the old homestead used to poke along:

"Tick — — — tock!
Tick — — — tock!
Tick — — — tock!
Tick — — — tock!"

how he told the hour just as accurately as your Waltham, with HALF THE HURRY?

The next time when Dick Roe—finishing his conversation with you—asks to be connected with the Sales Department, and you smilingly reply, "Hold the line a minute, please"—then, remembering the old grandfather clock, put your finger on the hook, and, as you move it slowly, say:—

"Tick (down) — — — tock! (up)
Tick — — — tock!
Tick — — — tock!
Tick — — — tock!"

(down and up four times).

Then wait to hear "United." If it does not come, repeat the exercise as before. When you do hear "United," ask the operator to please connect Mr. Roe with the Sales Department.

Transferring of calls is a constant source of annoyance and expense. Proper observance of the above instructions will remedy 50 per cent. of our telephone troubles. Moving the hook quickly makes no signal at all. In signaling the operator, remember—always:—

"Tick — — — tock!"

Bulletin No. 6, The Human Voice

When a man meets you face to face, he sizes you up by your appearance, your expression, your manner. When you talk over the telephone, voice calibre alone proclaims your appearance, your character, your ability and the ability and the character of the company for which you work. The blind are said to be very keen judges of human nature, and certainly telephone impressions seldom need revising.

A well modulated voice is indeed an undisguised blessing. But any voice, be it ever so raspy, is as a land flowing with milk and honey, provided it speaks right out with cheerful inflection, makes a business-like statement, and shows its owner to be concentrating his whole attention on the business at hand. Quality of voice alone means nothing. Calibre of voice portrays the calibre of man or woman.

When a man enters your office, do you amble listlessly toward him, hold out a weak, flabby paw, and wait for him to say "I am Mr. Black of the Black-Jones Shoe Company?" Of course you don't. You open fire the minute you set eyes on him—"How are you, Mr. Black? I'm glad to see you; come right in and have a chair," etc., and you give him a man's handshake. You've smoothed the way for the transaction of business.

Use the same method with the telephone. When the bell rings, take up the receiver promptly, and answer with a handshake in your voice—a live, tingling handshake. Use the rising inflection. Show Mr. Black that you're interested in what he is saying, even though he wants to talk to someone else. Speak up. Don't mumble your words. Ar-tic-u-late distinct-ly.

If you want a maxim, here it is: BE GENUINELY INTERESTED IN YOUR CALLER'S BUSINESS; ACQUIRE AN ACCOMMODATING SPIRIT—AND PRACTICE THE GOLDEN RULE.

Do these things and some day you will declare dividends on your voice.

Bulletin No. 10, In Conclusion

A certain man recently hung up his receiver, after a telephone conversation, and said to a friend at his side: "I have never met that young man face to face, but the way he talks over the telephone is typical of the whole organization of that house. They always answer every question in a polite and courteous manner. They never keep you waiting unnecessarily. They all seem to take a personal interest in what you have to say and you can be sure that your telephone requests will have the most careful attention."

When we hear the first man express exactly that thought in regard to our Corporation, we shall feel that these letters have accomplished the purpose for which they were intended.

Kipling says, that what wins the day

"—ain't the individuals,
Nor the army as a whole,
But the everlastin' team-work
Of every bloomin' soul."

* * * *

Americanization in Industry

By Winthrop Talbot M. D.

Adviser in Alien Education, Bureau of Industries and Immigration, New York State Industrial Commission

N this war for democracy—government of the people, by the people, for the people—the terms Americanism and Americanization have become familiar. If used with understanding they are full of meaning and inspiration, but in their application to industry they have often been employed vaguely and foolishly.

Americanism is an attitude of mind. It is induced through conviction, never through compulsion. It is a belief in *equal opportunity and obligation for all in mutual service.* It finds expression in actively maintaining the ideals and principles underlying American government, industry, and social conditions. Americanism cannot be taught; it must be fostered. It is the natural product of living under right American conditions.

Americanization is the wider spread of Americanism. In connection with our industries we are treated to frequent impassioned appeals to Americanize the alien worker. Campaigns of Americanization have been urged upon employers and their natural response has been one of cordial and loyal assent, but such campaigns too often have begun with perfervid oratory and have ended rocket-like with bewildering displays of glittering generalities. They have accomplished little because wrongly based. The appeal has been made mainly to sentimentality rather to sound business sentiment.

In general our alien workers need but little stimulation to their desire for and belief in the fundamentals of Americanism. What they do need is:

First, the mechanism of language to enable them to share in American thought.

Second, a better knowledge of the principles of Americanism.

Third, greater understanding of their obligations as residents in and citizens of America.

The two last depend upon the attainment of the first—the alien must be enabled to understand, speak, read, and write the American language.

Money Loss Through Lack of Americanism

The first step of importance in any campaign of industrial Americanization is that the employer himself shall be fully impressed with the money loss involved in employing workers who are unable to coöperate with him. Industry in America is abandoning once and for all the old-fashioned autocratic methods of employment. Today intelligent coöperation is requisite to success, and coöperation demands ability to think in like terms. A common language is the basis for mutual understanding and a working force speaking many tongues is an absolute bar to industrial unity. Diversity of language breeds suspicion, foments ill-feeling, favors injustice and exploitation, stimulates unrest, increases labor turnover, and multiplies labor cost.

New York State's Record of Illiterates

Teaching American to aliens is sound business practice. It is certainly a war measure of great importance as tending not only to more rapid production and elimination of waste; but it is not merely a war measure. By far the larger proportion of our costly labor disagreements have had their roots in fundamental inability on the part of great masses of workers to share in American thought. The greater part of our common labor consists of alien workers who can speak or read little or no American, and often are illiterate even in their own language. There are approximately 60,000 manufacturing establishments in the State of New York that rank as factories; these employ 2,000,000 workers, of whom 1,600,000 are foreign-born; 800,000 are unable t speak American, and 400,000 are technically illiterate—by this is meant inability to write at all in any language. More are unable to read even in their own language. Not less than 600,000 employed workers are unable to read any danger signs or work directions.

In 1916 from a total of 313,000 accidents reported in the State of New York to the State Industrial Commission, 58,500 were compensated, costing $11,500,000, or $40,000 a day. During 1917, accidents were reported at the rate of 1,000 a day at a cost of $13,000,000 per year as an initial expenditure, to which must be added the cost of medical benefits, administration of the compensation law, wages and cost of labor turnover, which has increased the total direct and indirect cost of accidents in New York State to $35,000,000, or at the rate of $117,000 per day.

Seven out of ten applicants for compensation require the services of an interpreter. When a man requires an interpreter to present his claim he is presumably unable to understand work directions in American, and for that reason alone is needlessly exposed to injury. If therefore about 70 per cent. of all industrial accidents in New York State are largely attributable to ignorance of the language in which safety directions are given, and by instruction in the factory for one hour a day for 50 days it is probable that one-half of the number of accidents could be prevented, the immediate gross savings to our industries would aggregate $50,000 a day![1]

THE FOREIGNER CAN LEARN AMERICAN IN TEN WEEKS

Practical methods have been devised whereby the illiterate alien may be taught to understand, speak, read, and write 500 American words and phrases in 50 hours of instruction one hour a day for 10 weeks. The cost of instruction for groups of workers should not average more than 20 or 25 cents an hour per person. Such classes should be conducted by trained, industrially minded teachers in factory hours without loss of wage. In addition, there should be instituted a general movement in the factory or works similar to a thrift, war savings, or Red Cross campaign, to enlist every one as *Americans All,* each agreeing to take on the responsibility for teaching some foreign-speaking neighbor. Plans for such a campaign are available, and to this end bi-language lesson leaflets have been formulated, called "Language Lesson Units" which may be put into the hands of every learner whereby steady progress in learning may result and be recorded.

Until the present time it has been difficult to obtain effective mechanism for teaching. Now there is slight excuse for any employer to be compelled to deal with non-American speaking workers on his pay-roll. The means are at hand.

The efficiency engineer neglects the first principles of his science when he neglects these facts and fails to insist upon one language for all workers as a basis for efficient labor employment methods. Labor has neglected too long to remove the obstacles to coöperative movements inherent in the lack of a common language.

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[1] "The English for Safety Campaign" by Marian K. Clark, Chief Investigator, Bureau of Industries and Immigration, New York State Industrial Commission, 230 Fifth Avenue, New York, N. Y.

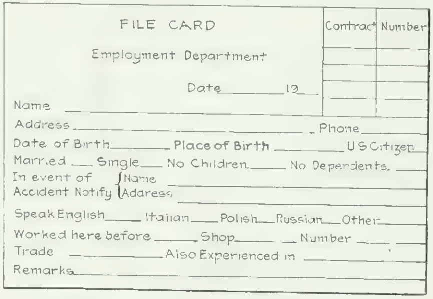
* * * *

A Simple Employment Plan

By J. H. Richardson

LABOR conditions since the beginning of the war have, of course, given great impetus to the growth of the specialized employment department idea. It is gratifying, nevertheless, to note this growth and the resultant improvement in provisions for the safety, health, convenience and training of employees.

As might be expected, however, employment "systems" are multiplying in number and also in complexity of detail and in elaborateness of forms. While there are still many large industrial establishments where the old methods of "hiring and firing" prevail, with the foremen leaving their departments at the very hour when their presence is most needed to "get the day's work started right" and going out to the gate to "pick up" help, on the other hand we find plants with thousands of employees almost all of whom are mechanics and laborers, skilled and unskilled, using an application blank consisting of four pages of more or less relevant questions as to the applicants personal inclinations and family history.



FILE CARD

Employment Department

Date ______ 19__

Contract	Number

Name ______

Address ______ Phone ______

Date of Birth ______ Place of Birth ______ U S Citizen ______

Married ___ Single ___ No Children ___ No Dependents ___

In event of Accident Notify {Name ______ Address ______

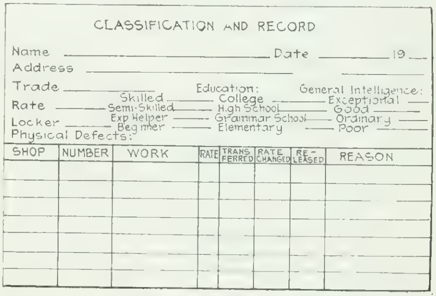
Speak English ___ Italian ___ Polish ___ Russian ___ Other ___

Worked here before ___ Shop ___ Number ___

Trade ______ Also Experienced in ______

Remarks ______

FIG. 1. FILE CARD FOR USE OF INTERVIEWER



CLASSIFICATION AND RECORD

Name ______ Date ______ 19__

Address ______

Trade ______ Education: General Intelligence:

Rate ______ Skilled ______ College ______ Exceptional ______

Semi-Skilled ______ High School ______ Good ______

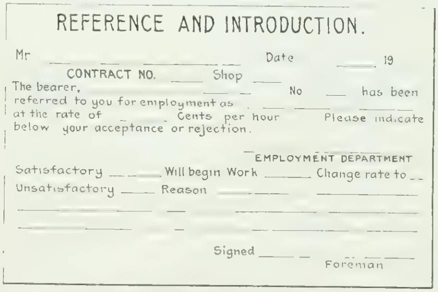
Locker ______ Exp Helper ______ Grammar School ______ Ordinary ______

Beginner ______ Elementary ______ Poor ______

Physical Defects:

SHOP	NUMBER	WORK	RATE	TRANS FERRED	RATE CHANGED	RE-LEASED	REASON

FIG. 2. CLASSIFICATION CARD FOR EMPLOYEE'S RECORD



REFERENCE AND INTRODUCTION.

Mr ______ Date ______ 19

CONTRACT NO. ___ Shop ___

The bearer, ______ No ___ has been referred to you for employment as ______ at the rate of ___ Cents per hour Please indicate below your acceptance or rejection.

EMPLOYMENT DEPARTMENT

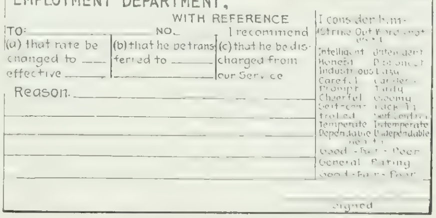
Satisfactory ___ Will begin Work ___ Change rate to ___

Unsatisfactory ___ Reason ______

Signed ______ Foreman

FIG. 3. INTRODUCTION CARD GIVEN TO FOREMEN

Between these two extremes there is a happy medium.



REPORT AND RECOMMENDATION

EMPLOYMENT DEPARTMENT, Date ______ 19

WITH REFERENCE

TO: ______ NO. ___ I recommend

(a) that rate be changed to ___ effective ___

(b) that he be transferred to ______

(c) that he be discharged from our Service

Reason ______

I consider him—

(Strike Out Word not Used)

Intelligent [illegible]

Honest Dishonest

Industrious Lazy

Careful Careless

Prompt Tardy

Cheerful Gloomy

Self-controlled Lack in Self-control

Temperate Intemperate

Dependable Undependable

Health

Good - Fair - Poor

General Rating

Good - Fair - Poor

Signed

FIG. 4. SLIP FILED WITH EMPLOYMENT DEPARTMENT

The following plan was worked out for a plant consisting of three divisions, each covering a considerable area and more or less separated from the others by natural or artificial obstructions, but all in one enclosure. There are three entrances or gates to the property on public highways from one-half to three-quarters of a mile apart. For the convenience of applicants, therefore, three employment offices must be maintained.

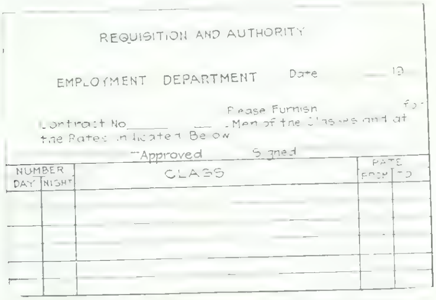
MEN EMPLOYED

Shop 191

Notice to Paymaster

FIG. 5. RECORD CARD FOR PAYMASTER

A central employment office keeps all records and maintains a staff of trained interviewers. These interviewers, in most cases, are skilled tradesmen selected because of their exceptional intelligence and good judgment, and trained in methods of interviewing.


REQUISITION AND AUTHORITY

EMPLOYMENT DEPARTMENT Date 19

Please Furnish for Contract No ______ ___ Men of the Classes and at the Rates Indicated Below

Approved Signed

NUMBER		CLASS	RATE	
DAY	NIGHT		FROM	TO

FIG. 6. REQUISITION BY FOREMAN AND SUPERINTENDENT

The three offices at the gates are in instant communication with the central office by telephone and an automobile runs back and forth between the central office and the gates for the convenience of applicants. At the gate offices are clerks who fill out for each applicant a file card (Figure 1), which indicates by trade or occupation the interviewer to handle the case, and also furnishes him certain necessary preliminary information and enables him to devote his attention to the kind and degree of skill, character, etc., of the individual.

Applicants arriving at the central office are distributed to the desks of the proper interviewers, who indicate their classification, grade, rating and assignment on a classification and record card (Figure 2), which becomes a permanent record card for this individual and shows his progress from time to time, the date of his final release and the reason. The result of the physical examination is also indicated on this card, the doctor's record of the examination being kept in his office adjoining the employment office.

Successful applicants are then passed by a desk where numbers are assigned and a "reference and introduction" slip filled out for each (Figure 3), after which they are escorted by messengers to the various foremen to whom they have been assigned. As each foreman has the option of rejecting any employee sent to him, the messenger waits for his decision and returns the reference and introduction to the employment office indicating the foreman's action. In case of rejection, the applicant is usually reassigned. If the reason for the rejection is such as to call for an investigation, the applicant is not employed unless the investigation results in his favor.

The file card is filed numerically, and the classification and record card is filed alphabetically, so that one file forms a cross index to the other and instant access is afforded to the records either by name or number.

The individual record is kept up to date by means of a report and recommendation slip (Figure 4) which the foreman is required to fill out and file with the employment department before any change in an employee's status becomes effective. Thus, no employee will be put on the payroll, nor any employee receive an increase in rate, unless the paymaster has received proper notice (Figure 5) from the employment department.

A simple requisition form (Figure 6) to be filled out by the foremen and approved by the superintendent completes the machinery of the plan.

* * * *

Study Industrial Conditions Not Turnover

By Holland L. Church

Employment Manager, Rockford Malleable Iron Works

THE writer has read with much interest the reports on different methods of computing labor turnover published recently in INDUSTRIAL MANAGEMENT, and it seems that in some instances the most important matter is missed. The value of a set of figures consists solely in the information they convey. If that information is of a purely academic character, it matters little whether they are obtained at all.

At this plant, where the writer organized an employment department about 18 months ago, we regard turnover as the number of employees it is necessary to hire for replacement in order to keep up a working force.

We subdivide our hirings and terminations along the following lines. When an employee is hired a record is made stating whether he was taken on to increase the force in some department, or whether he was secured to take the place of another employee who had terminated his services for any reason whatever. We consider turnover the ratio of such replacements to the force report for a given period.

It seems to the writer that the method of figuring turnover on the basis of either hirings or terminations, without subdividing as above stated, is somewhat arbitrary, and does not enable one to arrive at the most useful information. Take a concrete illustration. If John Jones, who has been working on a pension job for the past year, dies, it may not be necessary to replace him. There is, in such case, no real turnover involved.

Turnover figures are valuable only as they are an index to conditions in the plant.

Turnover study is simply a means to an end, and when that end is secured, namely, information regarding the number of replacements through avoidable terminations, it is time to stop figuring and get busy with the human element and with the physical conditions in the plant and its environs that have a bearing on the human element and its permanent attachment to the plant.

Editorials and Comment

Industrial Readjustment

THE war has been won; but it is not ended. It will not be ended until Germany, her Allies and Russia have stable democratic governments. It will not be ended until all the nations of Europe and the United States are producing every needful article for human welfare in abundant quantities.

In America our government is stable, so our problem is industrial. At once we must begin the great task of industrial readjustment directing all of our energies toward peace production.

Up to the immediate present our efforts have been concentrated on winning the war and our industrial achievements have been in the production of war material. We have not looked into the future so much as, for instance, great Britain. For a number of months there has been an active section of the British Government known as the Ministry of Reconstruction. Under its direction are some twenty committees, each one investigating and studying the needs of some important branch of British industry. Work of a similar nature has not yet been started in the United States, but it is not difficult to point out some of the particulars of the great problem that we are facing.

In due time three million or more Americans will be demobilized. What will be the process of taking them back into productive occupations? Several hundred thousand women are now working in our factories. What will they do? Will they stay where they are? Will they go back to their former conditions of living, supported by men, or will there be a tendency for more women to enter industry when the peace boom becomes a fact? What will happen to existing war contracts? This query is already being answered by cancellations. How serious will be the period of hardship stretching over the time of change from manufacturing war articles to producing peace goods?

What will be done with the special equipment with which our shops are filled, developed for making munitions and of little use for anything else? What lines of manufacture will be taken up by our many enormous plants that were built to make a specific war article, as rifles, shells, fuses and the like? What will the men and women now working in these plants do until the business arrangements for the new products have been perfected, orders received to warrant the beginning of manufacture, and the manufacturing equipment purchased, installed and made ready to operate? How difficult will be the problem of rebuilding the organizations for the peace industries of this country? Without doubt, no part of the organizations have been more disrupted than those which conducted the work of marketing before the outbreak of war. Generally speaking, goods must be sold before they are manufactured.

How great will be the difficulty of getting raw material of proper kind and quality to enter into the manufacture of automobiles, pianos, textiles, machinery, railroad equipment and all else that must be turned out to meet the normal demands of trade?

The standard of living set up in many places due to housing developments for war industries must be further extended to older and established industries where living conditions are far from being in keeping with the best standards for health and comfort. Will not many industrial communities face an industrial housing problem of their own?

During the months of war there has been a recognition of certain principles in the conduct of labor, namely: The right to organize, collective bargaining, the 8-hour day and the right of representation when changes or modifications are discussed in wages, rates and working conditions. Will these same principles continue to be recognized after the war ends? It has been frequently pointed out that today employees have far more control of their own working conditions than ever before. It is freely said that the influence and experience of army life will bring back many men possessed with the qualities of leadership. What will be the nature of the problem in granting workers a voice in their own control and management?

What will happen to wages? Some readjustments must take place. War wages cannot prevail in peace manufacture. Perhaps the most we can hope for in this direction is that the readjustment will be gradual, extended over a considerable period of time, influenced by a falling in the cost of living, and be so conducted that there will be a minimum hardship to all concerned.

Now for a final part of this problem! Industrial readjustment is about to place a tremendous burden upon executives—bringing back the effectiveness of labor, obtaining an adequate output from productive machinery, and increasing the efficiency of our entire production. This is the overshadowing problem of all. In this is summed up the tremendous task of industrial readjustment in this country. For its solution all of the engineering and industrial executive ability will be required for years to come. And the degree with which it is finally worked out determines the place that the United States will occupy, not only as a power among the nations of the earth, but especially in regard to its internal and foreign trade relations.

* * *

Labor Turnover Once More

The extended discussion in regard to what is labor turnover that has been printed in INDUSTRIAL MANAGEMENT indicates, perhaps, a bit of irritation with the ideas that have been so far advanced. Frankly, is it not rather absurd to work out turnover percentages and get results of 1000, or 1500, or 2300 per cent., or some other large and outrageous figure? Although we have become accustomed to talking in billions—whether we think in them or not is quite another matter—we are not yet used to figuring and comprehending percentages by the thousand. It may be that a violent jolt, from some one who has the imprudence to tell us that our present methods of defining and computing labor turnover are all wrong, will have the happy effect of beginning to "clear the air."

To get at the philosophy of the matter Mr. William L. Albro offers this interpretation:

"When we hire a worker—man or woman—we make an industrial investment. The use of our plant facilities and equipment by that person, and everything we do for him through training, service and the like adds to our investment in him. The experience that he gains in our employ, whereby he is able to do better and more work, and the spirit of loyalty and coöperation that he acquires still further add to our investment due to his employment.

"Now it is quite proper that we should make this industrial investment, indeed we must do so if we are to manufacture and produce. So making this investment is a normal function of industry—it is the loss of this investment that hurts.

"Labor turnover is the term that we are now applying to this industrial loss. One of the purposes of an employment department is to reduce labor turnover, that is, to keep down the loss of the company in its investment in employees. This function is a preventive one, and like many other preventive responsibilities the work must begin a long time before the crisis of impending loss is reached.

"Therefore, the employment department must hire men and women suited for the jobs that are open, must introduce the newcomers into their work under conditions that will create a favorable impression, try through every proper means to make them contented and effective so that they will stay, and thus prevent the investment loss that would occur through their leaving.

"It is evident that it is more important to hold the man who has already been hired than it is to hire the applicant at the gate."

Once we accept this viewpoint and hard-headed argument we will see that separations become the measure of labor turnover. Under this heading are: quits, discharges, layoffs and releases for whatever cause. The greater they are the greater the investment loss, and the worse is the record of the employment department.

If we once accept a line of reasoning like this and its conclusion it will not be difficult to develop a mathematical expression which will give us a result in figures that may be useful, although it is more than likely in the final consideration that the results of no formula would present a true picture of conditions in even an average number of cases. What an employment manager really wants to know is why his men are leaving so that he can take the proper preventive measures in regard to those who have not already separated, and knowledge of this kind is not conveyed by a percentage nor by the result of any computation no matter what formula may be employed.

* * *

Shipbuilding Management

With the firing of the last shot at the Germans at 11 o'clock Monday morning, November 11, passed the necessity of manufacturing war material, but did not relieve us of the urgency for building ships. The shipbuilding industry is quite apart from that of making munitions and war supplies.

According to a statement issued by the United States Shipping Board on September 1, 1918, the loss of Allied and neutral shipping from August, 1914, to September 1, 1918, was 21,404,913 tons dead weight; the total construction during the same time was 14,247,825 tons; enemy tonnage taken to the end of 1917 was 3,795,000 tons, giving an excess of losses over gains of 3,362,088 tons. Here is a large net loss to be made up, and in addition the normal tonnage increases that would have occurred during the last four years had there been no war.

It is evident, therefore, that our shipbuilding program cannot be abandoned although it may be modified in character. On this point the country has been reassured by Chairman Hurley, of the Shipping Board, and Director-General Schwab, of the Emergency Fleet Corporation.

The leading article in INDUSTRIAL MANAGEMENT for November pointed out that the solution of the shipbuilding program as it then existed was "management." If we are to continue to build ships under the authority of the Emergency Fleet Corporation—as we must do—this problem is still with us. Simply put, it is the overcoming of inefficiency in the shipyards.

Mr. Churchill's article referred to above lays the foundation for the suggestion that had things continued as they were an organization of some kind should have been created under the Shipping Board to improve the management of the yards. Perhaps we might call this body a Shipbuilding Management Board.

Although this suggestion is to a certain extent in retrospection as something that we wish might have been done, for if properly handled it would have been the greatest example of industrial management that the world has ever seen, yet it is possible that the same idea has force and point today.

Without doubt those who have been active in directing the affairs of the Emergency Fleet Corporation will be the last to deny or minimize the inefficiency in handling labor, controlling materials and building ships—the country is pretty well convinced that this inefficiencies have persisted in a majority of the yards. Now after the plans change, with perhaps a turn to cargo boats that must be so substantially and economically built that they can compete in the world's foreign trade throughout a normal length of life, it may be that the necessity for bracing up the yards industrially, eliminating their inefficiencies and producing for a reasonable cost in time, labor and materials, will add emphasis to, rather than detract from, the suggestion to establish a Shipbuilding Management Board.

Such a board might properly be given authority to designate methods, plans and practices to be adopted by all shipyards, have the power to assist the management of lame yards and actually to manage inefficient yards if this course should become necessary. Its creation would mean that individual shipyards would have an authoritative advisory counsel to keep them informed of the best developments in every detail of shipbuilding, and be able to call for the assitance of technical and trained men to help in putting into effect any plans, methods or schedules that otherwise might be difficult to introduce.

American industry has very little to be proud of in regard to the degree of its efficiency during the war. If now, in this great effort for shipbuilding that is to continue for many months, the best of our knowledge of the principles of industrial management can be put into effect, there will shine an example and arise a stimulus that may bring a real industrial awakening.

* * * *

Here and there well managed industrial plants have studied means for reclaiming scrap materials and salvaging waste and have brought their methods to a high point of efficiency. But in general the average plant is negligent in this particular. The shop dump is still too often in evidence, where paper, lumber and many other kinds of combustible waste are burned or are left to be picked over by thrifty Italian families.

The months of high prices of industrial materials, and the difficulty of obtaining materials at any price, have stimulated savings in many plants. Let us hope that the beginning thus made and the experience acquired during days of necessity will persist until every industrial plant shall have its reclaiming and salvaging department, and will save as a duty every particle of industrial material and waste that can be utilized for any purpose whatsoever.

* * * *

For more years than we like to think we have been lectured and addressed and written to in regard to the fire hazard in industry. But apparently so little progress has really been made that one of the major duties of the Plant Protection Section of the Military Intelligence Branch of the War Department was seeing that proper fire protection was established in plants making war material. Reading of the hazards commonly discovered and means taken to guard against them almost leads one to believe that the average industrial plant never heard of fire or means for preventing it.

The influence of this Plant Protection Section is one of the happy things that will stay in industry now that the war is over. In an interesting fashion Mr. Edmund Leigh tells on page 504 what his organization has accomplished.

* * * *

The keynote session of the annual meeting of the American Society of Mechanical Engineers, which opens on Tuesday, December 3, is on "The Engineering of Man Power." In selecting this topic there is a recognition of the place that labor occupies in industry and, therefore, in engineering. There is also recognized the fact that the really big engineer and industrial executive of the future will be a handler of men, not things.

* * * *

To-day's demands on industry are:
Maximum production; minimum waste; standard cost.

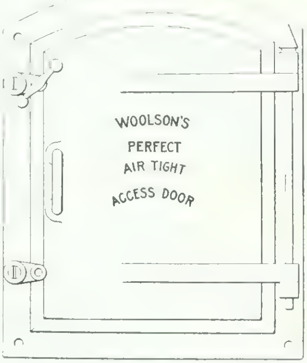
Factory Equipment News

The Latest Labor-Saving Machinery

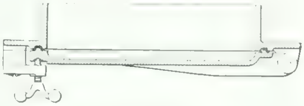
Woolson Boiler "Access" Doors

THE Woolson boiler "access" door has been developed to provide an airtight door under all conditions of handling and changes of temperature. The requisite of such a door is first a frame of sufficient rigidity to keep its shape and so anchored into the brick work as to remain always snug and tight, and a fitting of the door itself against the frame so that the filtration of air will be reduced to a minimum.

The construction of the door illustrated herewith is such that it can be packed with plastic material when first installed and remain in that condition a long time so that the door when being opened and closed fits against this packing material after having been first peppered with black lead. If, however, parts of this packing break away during long use it is an easy matter to make a repair with the same or similar plastic material. All irregularities or beading of the door fit into corresponding impressions in the packing, thus forming an airtight joint.



FRONT VIEW OF DOOR SHOWING FASTENER



DETAIL OF SWINGING CLIP FOR FASTENING DOOR

The door is fastened by means of a swinging clip instead of the ordinary latch because the latter must be brought to a certain position to fasten, and the set screw on the swinging clip permits of proper adjustment of the door against the plastic packing. As many access doors are located in dark spaces there is a counter-sunk spot on the door into which the point of the set screw can be brought by the sense of feeling and the fireman can be assured that the door is properly closed.

This access door is manufactured by Mr. O. C. Woolson, 39 Cortlandt Street, New York City.

Palmer Slack Burner

AN installation of the Palmer burner system consists of a set of burners, a blower, automatic regulator for maintaining constant steam pressure and the necessary fixtures, piping, dampers, air ducts and the like. The feature of this installation is the burner itself. Figure 1 shows a boiler furnace setting equipped with these burners, while Figure 2 is of a complete section.

Turning to Figure 1 in front of the boiler is indicated the damper for letting in or cutting out the air to any one boiler of a battery. From this damper, and under the surface, the air duct for conveying the air is extended to the rear of the burner and is distributed separately to each section of the burner. Each burner section has a separate connection to the air duct and the air is brought in contact with the flow through the air inlets indicated by the numerous disk-like plates, or tuyeres, shown at the upper surface of the setting. These burners take the place of the ordinary grate bars or shaker grates, fit close together and form a closed fire box. Around the edge of the tuyere is an air space about ⅛-inch in width, though this is varied for different classes of fuel. The edges of these air spaces are beveled to give the air a flaring direction as it emerges from the burner. No air enters the fire box except through these air spaces and no coal or ashes fly through the burners. The fine dust that may sift through the tuyeres opening when the fires are cleaned is removed by slides in the bottom of the burner operated by a lever and shaker attachment at the boiler front.

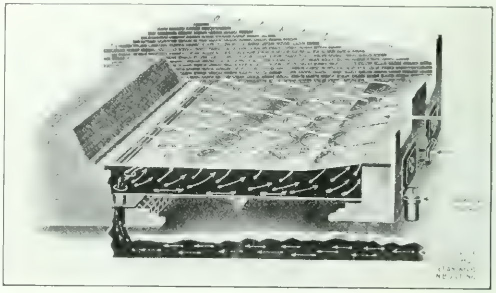


FIG. 1. FURNACE EQUIPPED WITH PALMER BURNER

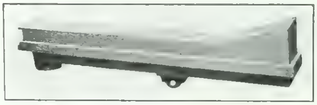
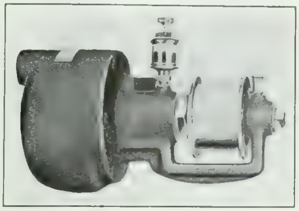


FIG. 2. ONE SECTION OF PALMER SLACK BURNER

These burners have been used for burning all of the various kinds of coal mind in the United States as well as the lowest grades of slack or screenings, bagasse, spent tan bark, lignite and coke breeze. The installations are put in by the Palmer Forced Draft Slack Burner Company, Fort Scott, Kansas.

The Fulflo Grinder Pump

TO meet the need for a pump to handle lubricant and coolant for small grinders, drill presses, milling machines, tool cutters, hack saws and the like, the Fulflo Pump Company, Blanchester, Ohio, has developed a small direct driven pump which is illustrated herewith. It is provided with a $\frac{3}{8}$-inch intake and outlet and has a capacity up to five gallons per minute when compound or water solutions are used, and three gallons per minute for mineral lard or oils of high viscosity. In general design it follows the other sizes of Fulflo pumps embodying the principle of centrifugal action and may be placed above the level of the liquid to be handled and still remain primed under all conditions. There is only one internal working part—the impeller. The pressure is not accumulative and therefore no relief valve or overflow piping is required since the flow is entirely controlled by the stop cock at the outlet of the piping and this may be opened or closed at will. The pump may be permitted to run indefinitely with this stop cock closed without damage either to itself or to the piping.


FULFLO GRINDER PUMP

The bearings of the pump do not come in contact with the liquid and are independently oiled through lubricators. The shaft is hardened and ground and all other parts except the bearings, which are of bronze, are made of cast iron. Pumps constructed entirely of bronze or brass can be furnished. The packing is of the flexible metallic type.

A pad for mounting the pumpis is located at the bottom and when it is desired an angle bracket is furnished to which this pad can be bolted. This arrangement permits the mounting to be made either at the back or front. The overall dimensions are $7\frac{7}{8}$ x 5 inches; the driving pulley is $1\frac{1}{2}$ inches in diameter and either a 1 or $1\frac{1}{4}$ inch belt may be used. The pump is built to withstand speeds up to 3,500 r.p.m. It weighs complete $9\frac{1}{2}$ pounds.

* * * *

Reclaiming Leather Belting

INDUSTRIAL plants have always faced difficulty when endeavoring to dispose of discarded leather belting. In general belting manufacturers frown upon the idea of making over used belting. So it has been customary to sell discarded belts to leather junk men, who degrease and clean them and sell the resulting product to shoe manufacturers for soles of the cheaper grade of shoes.

PILE OF USED LEATHER BELTING

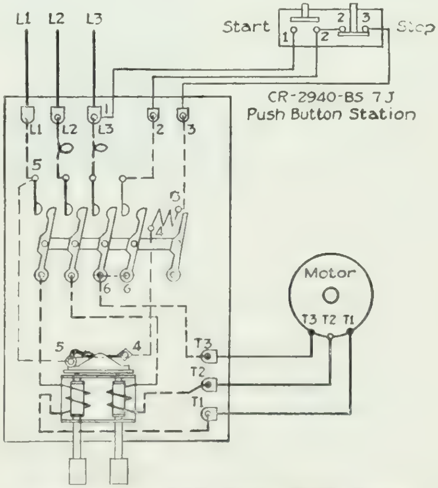
However, the increase in the cost of belting has caused the F. Raniville Company, Grand Rapids, Michigan, to establish a plant for the exclusive purpose of reclaiming and remaking leather belts of the kind that had been formerly thrown away. This plant is known as the "belt laundry" Processes have been developed for removing the resinous dressings; grit, machine oils, gum, etc., from discarded belts. In this connection it is interesting to point out that the process that will clean a belt from a textile mill will not serve for one that is full of cement dust. So a variety of solvent baths and cleaning processes have been evolved to care for various conditions. It is evident, also, that belts damaged by water, fire, abuse, acids and general wear and tear must each receive a different treatment. After the leather has been thoroughly cleaned and dried out, it is recurried with animal fats following the same process as is used in treating new leather from the tanning vats. It is then restretched and recemented into what is termed "Ranivilized Belting."

USED BELTS MADE OVER BY RANIVILLE METHODS

* * * *

Remote Control Starter for Small Motors

THERE is often need for a device to start small induction motors from remote points by throwing them directly across the line. For this service the Gen-



CONNECTIONS FOR REMOTE CONTROL MOTOR STARTER eral Electric Company, Schenectady, N. Y., has recently placed on the market a starter known as the CR7006-A1, a remote control switch arranged for push button control. This device is applicable for the use of motors up to and including 5 horsepower, 110 volts, and 7½ horsepower, 220, 440, and 550 volts.

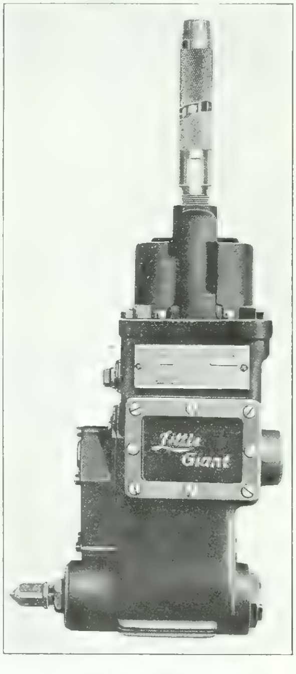
The starter consists of a 25 ampere, 3 pole contactor with two inverse time limit gravity reset overload relays mounted on a slate base and completely enclosed in a sheet iron case. A small "start and stop" push button station is used as a remote control switch. When the "start" button is pressed it completes the starting circuit and energizes the coil of a magnetically operated switch thus closing the contacts and throwing the motor directly on the line. An interruption of the circuit or a large drop in voltage permits the contacts to reopen by gravity thus stopping the motor. The motor cannot start again until the "start" button is pressed.

* * * *

Little Giant Corner Drill

A CLOSE quarters drill manufactured by the Chicago Pneumatic Tool Company, Chicago, Illinois, has been designed to overcome the objection arising from the intermittent action of ratchet levers when employed to rotate a spindle. This is known as the Little Giant corner drill and is illustrated herewith.

The drill spindle is rotated through a train of gears, and the design is such that the drill can be used in a narrow space or within 1 7/16 in. on an end wall or corner. The gears are of the stub tooth type which gives strength and an increased tooth thickness at the root over a standard involute tooth. Furthermore, the material in these gears is a special alloy steel.



LITTLE GIANT CORNER DRILL

* * * *

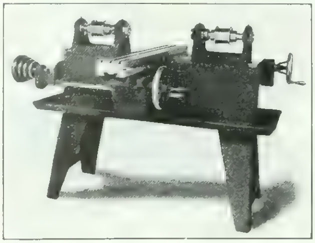
Garvin No. 1 Duplex Miller

A RECENT addition to the line of milling machines made by the Garvin Machine Company, New York City, is known as the No. 1-X duplex. It is shown in the illustration herewith and it seems to be provided with simultaneous wheel control to the spindle head so that both heads may be moved at the same time.

The capacity of the machine is as follows:

Feed of the table 34 inches; distance between spindle heads 22 inches. This capacity permits the machine to handle larger pieces than the regular No. 1 duplex machine made by this firm.

This type of machine is particularly designed to meet the requirements of economical and rapid manufacture of standard articles such as hardware specialties, brass goods, typewriter parts, cash register parts and the like. The size of the table presents an ample surface for holding fixtures and the requirement of rapid production is met by the power feed with automatic trip and quick return by a hand wheel. Changes of feed are provided from a cone pulley driven from the countershaft.

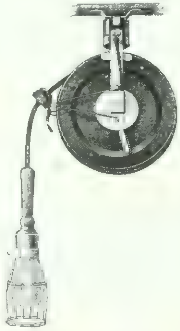


GARVIN NO. 1 DUPLEX MILLER

* * * *

Automatic Reel for Electric Lamps

AN automatic extension reel for electric lamps designed to be used in factories is shown in the accompanying illustration. The reel itself is 9 inches in diameter by 2 inches in width and is provided with 25 feet of reinforced cord. The support for the reel is provided with a swivel joint permitting the cord to lead off in any direction. It is provided with an automatic lock so that any position of the reel and any amount of unwound cord may be held. The automatic lock catches and holds the cord through a slow backward movement after it has been unwound to the desired length. To rewind it is merely necessary to give the cord a slight pull which unlocks the catch and the reel then automatically rewinds the cord as the person holding the lamp walks toward the reel holding the lamp in his hand. This device is manufactured by the Cincinnati Specialty Manufacturing Company, Inc., Cincinnati, Ohio.

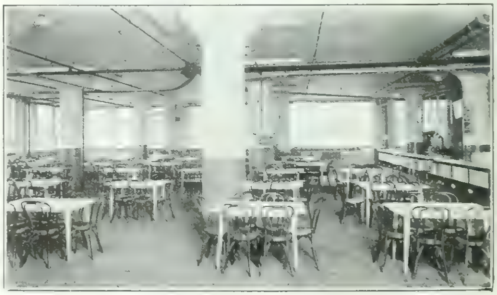


AUTOMATIC LAMP REEL

* * * *

Lunchroom Equipment

THE arrangement and equipment of a recently installed factory lunchroom is shown in the accompanying illustrations. The equipment was supplied by the Chicago Hardware Foundry Company, North Chicago, Illinois. The counter and tables are covered with



LUNCH ROOM AT GERA MILLS, PASSAIC, N. J.

LUNCH COUNTER COVERED WITH SANI-ONYX

a white vitreous product known as sani-onyx, which is non-porous and does not stain or absorb grease. The bases of the tables are of metal covered with white porcelain enamel, so that any dirt which may reach them when the floors are mopped can be removed by a damp cloth. The chairs in this installation are of bent wood shown in the illustration on page 518.

Personal and Business Items

The Chicago Pneumatic Tool Company announces the election of Mr. H. D. Megary to the office of secretary, Mr. W. B. Seelig, resigned.

* * * *

The Austin Company announces the removal of its division office from Detroit to the Continental and Commercial National Bank Building, Chicago, Ill.

* * * *

The Chicago Pneumatic Tool Company, Chicago, Illinois, announces the appointment of Mr. A. M. Brown, as district manager of sales at Philadelphia. He succeeds Mr. G. A. Barden, who remains in Philadelphia as sales representative for the company.

* * * *

Mr. J. C. Rockwell, the present general manager of the Manila Electric Company and Light Company, is being placed in full charge of the affairs of that company in Manila by The J. G. White Management Corporation, New York, N. Y., the operating managers of the property.

* * * *

Mr. L. G. Buske who for 28 years has been connected with The Shaw Electric Crane Company of Muskegon, Michigan, as erecting engineer and service man has resigned his position and has accepted a responsible position with The Champion Engineering Company of Kenton, Ohio.

* * * *

The Beaumont Manufacturing Company, Philadelphia, Penn., has issued a new catalog No. 37, which describes, illustrated and gives dimensions of standard Beaumont gates for controlling the flow of granular material from bunkers. The design of ash pits under boilers and the correct gate to use in such installations

* * * *

The Fulflo Pump Company, Blanchester, Ohio, has reissued its booklet "15 Gallons Per Minute" using the material which has appeared in previous editions and adding three new pages presenting detailed specifications of the two types of pump manufactured by this firm, namely, the machine tool and the grinder pump.

* * * *

Mr. C. Nesbit Duffy has resigned as vice-president of the Manila Electric Railroad and Light Company, Manila, P. I., to accept the position of vice-president of the Visayan Refining Company, Manila, P. I., one of the largest cocoanut oil companies on the Philippine Islands. Mr. Duffy took over his new duties on November 1.

* * * *

The Coppus Engineering and Equipment Company, Worcester, Mass., has issued a 52-page catalog devoted to its turbo blower for undergrate draft and other industrial purposes. The construction of the blower and its principal parts are shown in detail; two pages give the principal dimensions and a number of other pages are devoted to showing applications.

* * *

Six manufacturings firms of Worcester, Mass., have combined in producing a striking color poster to advertise their products. These firms are: The Boston Pressed Metal Company; Coes Wrench Company; The Graton & Knight Manufacturing Company; Loring Coes & Company; The White & Bagley Company; The Wright Wire Company.

* * *

The Gisholt Machine Company, Madison, Wisconsin, has just issued two folders one devoted to the periodograph, a factory instrument for reporting the time that an employee works on each job, and the other to Gisholt tool holders by means of which small pieces of tool steel can be used up. The latter has a table of complete dimensions, sizes and prices.

* * * *

The completion of the Victory Mills, near Saratoga, N. Y., for the American Manufacturing Company, of Brooklyn, N. Y., manufacturers of oakum, has been turned over to the Aberthaw Construction Company, Boston, Massachusetts. The building will be a five-story structure, 280 by 169 feet, of reinforced concrete with wood interior supports, beams and laminated floor.

* * * *

The American Electrical Heater Company, Detroit, Mich., announces that it has materially reduced the production of all its heating devices for household use and is devoting its entire capacity to the manufacture of soldering irons, glue pots, air heaters, hot plates, stoves and other electric heating devices for industrial use.

* * * *

The Austin Company, Cleveland, Ohio, is sending out an 8-page folder devoted to standard factory buildings constructed of wood. Brief specifications are given for five types, each one of which has a wood lattice truss. At the present time when steel is unattainable this bulletin will be of particular interest to any one considering the erection of industrial buildings.

* * * *

The Ilg Electric Ventilating Company, Chicago, Illinois, has just issued an 8-page folder devoted to the Ilgair heating system for spacious buildings. The unit heater described is a cabinet in which is housed a two stack radiator and a motor driven fan. The cabinet serves as a heating chamber for air that is drawn over the heated coils on the intake side at low velocity—about 1000 feet per minute—and discharged at about 2500 feet per minute.

* * * *

The Brown Hoisting Machinery Company, Cleveland, Ohio, presents catalog D-1919, devoted to trolleys, tramrail systems, hand travelling cranes, electric hoists, monorail man-riding trolleys, crabs and winches and portable floor cranes. The 56 pages of the pamphlet are profusely illustrated showing both details and installations of the various items of equipment. One feature is a series of tables giving dimensions and in many cases prices of standard parts.

Mr. John W. Watson, president of the American Bronze Corporation has become assistant chief of the Hispano-Suiza engine section of the Bureau of Aircraft Production. His responsibilities include all of the engineering, production and inspection work of this section, involving the expenditure of some $80,000,000 in engines and spare parts.

* * * *

The Schaeffer Engineering & Equipment Company, Tiffin, Ohio, has just issued bulletin No. 5 devoted to poidometers. These Schaeffer poidometers are proportional weighing machines developed for continuous weighing of material which is contained in a bin or hopper and from which it is delivered and weighed. These machines are built in four numbered sizes for capacities from 1½ to 50 pounds per minute, and will handle granular material as coarse as 4-inch cubes.

* * * *

Mr. Matthew C. Dittmann, vice president and treasurer of the American Bronze Corporation, has been appointed general manager. Mr. E. C. Anderson has now become advertising manager, and Mr. C. H. Baker, formerly auditor of the Timken Roller Bearing Company, has been appointed assistant to Mr. Dittmann in charge of the accounting and financial departments. These changes have been brought about by the recent appointment of Mr. Watson to the Bureau of Aircraft Production.

* * * *

The Crescent Belt Fastener Company, New York City, has just issued an advertising booklet that is out of the ordinary. Its title is "Come Again" and it is sub-titled as "The Great Educational Film." The star of the cast is "Bertha Belting" and the 24 pages of the booklet tell of her journeying and troubles. Of course, everything comes out right at the end for she is saved by the hero, little "Mr. Crescent" who supplies the proper fastener to hold Bertha's loose ends together.

* * * *

The Webster & Perks Tool Company, Springfield, Ohio, have incorporated in a 20-page booklet an address given by Mr. W. T. Montague entitled "Economical Use of Grinding Wheels." Such practical points as cutting action, wheel grade, action of a grinding wheel, condition of a grinding machine and wheel safety are discussed; also a number of actual records of wheel performance are given, and two pages show safety devices for grinding machines.

* * * *

David Lupton's Sons Company, Philadelphia Pennsylvania, has just issued a 48-page booklet entitled "Air and Light in Foundries and Forge Shops." It is devoted to showing the influence of sash types and roof design in removing smoke and gas from forge and foundry buildings. Many illustrations are shown of both exteriors and interiors, as well as details of the sash and its operating devices. Several pages are devoted to machine shops and one to the problem of remodeling old buildings.

* * * *

Mr. Robert C. Byler, for nearly four years advertising production man for the S K F Ball Bearing Company, of Hartford, Connecticut, has been appointed advertising manager of the S K F Administrative Company of New York City and will direct the advertising of the S K F Ball Bearing Company, of Hartford, the Hess-Bright Manufacturing Company of Philadelphia and the Atlas Ball Company of the same city, all of which are controlled by the S K F Administrative Company. Until arrangements are made in New York City Mr. Byler will remain with the S K F Ball Bearing Company of Hartford, Connecticut.

* * * *

Mr. H. L. Treeman has been promoted by The J. G. White Management Corporation, New York, from industrial engineer of that organization to the position of manager of the electric department of the Eastern Pennsylvania Railways Company and the Eastern Pennsylvania Light, Heat & Power Company, of Pottsville, Pennsylvania.

* * * *

The Jones & Lamson Machine Company, Springfield, Vermont, has issued under date of 1918 a new catalog on the Fay automatic lathe. It is in the form of a 6x9 book of 86 pages and is divided into six sections with these titles: Solving a Shop Problem; Description of the Machine; Advantages of the Fay Automatic; Examples of Work; The Fay Automatic Bevel Gear Lathe, Fay Lathe Accessories. The pages carry 56 illustrations of the machine, its tools, its important parts, methods of setting up and its accessories. Taken all in all it ranks among the very best examples of advertising literature of machine tools.

* * * *

The Wetmore Mechanical Laboratory Company, Milwaukee, Wisconsin, announce three new leaflets, Nos. 51, 52 and 53. The first describes and illustrates thread-milling hobs for shells, which are made in sizes for use on various kinds of thread-milling machines. The second is devoted to solid and expanding taps especially adapted for sizing fuse hole threads in shells. The third leaflet is a two-page circular describing expanding reamers made for finish sizing fuses of the United States and British high explosive shells.

* * * *

Tate, Jones & Company, Inc., furnace engineers, Pittsburgh, Pennsylvania, has just issued a 16-page illustrated pamphlet showing furnaces of large capacity. The views and accompanying illustrations are of car-type steel heating furnaces, annealing furnaces for large forgings and flanged parts of boilers, for case hardening, for heating steel shafts and other parts for heat treating, for drying foundry molds, for annealing axles, for case hardening gears and automobile parts, and for heating brass billets.

* * * *

The Fellows Gear Shaper Company, Springfield, Vt., has just issued an instructive book on the "internal gear." While this type of gear is known to possess many advantages over other types when applied to reduction drives it has not had the adoption that it deserves largely because of the lack of knowledge of its proper application. So this 94-page book has been written for those who are interested in the design, application and cutting of such gears. It is strictly an engineering text book having 5 chapters with the following headings: Definition and Advantages of the Internal Gear; Design of Internal Gears; Graphical Analysis of Tooth Action of Internal Gears; Internal Helical Gear design; Cutting Internal Gears; Various Applications of the Internal Gear. The pages carry 65 illustrations and numerous tables of tooth parts and rules and formulas useful in designing such gears. While not by any means in the nature of advertising literature, this booklet is for free distribution and will be sent to anyone who is interested.

The Engineering Index

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world in the English, French, Dutch, Italian and Spanish languages, as far as possible on account of war. The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us. The Explanatory Note is given in the Index Section of INDUSTRIAL MANAGEMENT, where also the full titles of the principal journals indexed are given. This list is subject to change from time to time.

NOTE.—The Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

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INDUSTRIAL MANAGEMENT

EDUCATION

Chemistry

The Importance of Practical Chemistry (89432 B). G. W. Thompson. 1200 w. Jl Ind & Eng Chem—Oct., 1918. Its value in peace and war. Its applications in the industries.

Chemists

The Work of the Chemical Section of the War Industries Board (89429 B). Charles H. Mac Dowell. 2500 w. Jl Ind & Eng Chem—Oct., 1918. Outlines the work accomplished.

The Place of the University in Chemical War Work (89431 B). E. W. Washburn. 3500 w. Jl Ind & Eng Chem—Oct., 1918. The training of chemists, and research on war problems.

The American Chemist in Warfare (89428 B). Charles L. Parsons. 6000 w. Jl Ind & Eng Chem—Oct., 1918. The marvelous chemical development since the war. Departments and bureaus utilizing chemists.

Engineering

Broader Foundation Demanded for Engineering Education (89131 A). Frederic Bass. 2000 w. Eng News-Rec—Sept. 26, 1918. Ways in which engineering education needs to be modified.

The National Engineering Societies and the National Research Council (89282 A). Dr. George Ellery Hale. 5500 w. A S M E, Jl—Oct., 1918. Reviews the development of engineering in the United States.

Education Needed for Present Engineering Demands (89666). Ills. 4000 w. Elec Wld—Oct. 26, 1918. Abstract of Dr. C. R. Mann's report on his three-year study of engineering education.

Research

Scientific and Industrial Research (89332 A). 2500 w. Engr—Sept. 6, 1918. Serial, 1st part. Summary of the labors during the past year of the Committee of the Privy Council for Scientific and Industrial Research.

Technical Literature

Le Traitement De La Littérature Scientifique (89712 B). P. Otlet. 7000 w. Rev Générale des Sciences—Sept. 15-30, 1918. Coöperation of scientific associations for classification and management of technical literature.

Training Schools

Packard Training Schools for Employees (89696 A). D. G. Stanbrough. 3000 w. Ind Man—Nov., 1918.

War Gas

Chemical Warfare Research (89430 B). Wilder D. Bancroft. 1500 w. Jl Ind & Eng Chem—Oct., 1918. Outlines the research work in developing a war gas.

War Instruction

War Instruction at Massachusetts "Tech" (89263). Ills. 2200 w. Elec Wld—Oct. 5, 1918. Account of instruction and research work in military, naval and aeronautical fields.

FINANCE AND COSTS

Accounting

Cost Accounting to Aid Production—II (89692 A). G. Charter Harrison. 6800 w. Ind Man—Nov., 1918. Necessity of establishing a system of standard costs before planning and dispatching methods are installed.

Capital Accounts of a Municipality (80567 A). Henry B. Fernald. 9 pp. Jl Actcy—Oct., 1918. Proper treatment of capital accounts and some problems.

Governmental Sinking Funds, Serial Bonds and Depreciation Reserves (89566 A). Harvey S. Chase. Address at Quebec. 15 pp. Jl Actcy—Oct., 1918. Illustrations and explanations of problems.

Assessments

The Cambridge, Mass., System of Real Estate Assessments (89407 B). Stoughton Bell, with discussion. 8800 w. Bos Soc C E, Jl—Sept., 1918. Explains study made to equalize values and the application of the system.

Cost-Keeping

Highway Cost-Keeping (89565 N). James J. Tobin and A. R. Losh. 52 pp. U S Dept Agri, Bul 660—Sept. 12, 1918. Principles which govern cost keeping, and their application to highway work.

Cost System

Cost System for a Medium Size Foundry (89239 A). D. O. Barrett. Forms. 2200 w. Iron Age—Oct. 3, 1918. Various forms which have proved their usefulness.

Employment

Employment Department and Routine of the Curtiss Aeroplane and Motor Corporation (89698 A). Charles E. Fouhy. 2000 w. Ind Man—Nov., 1918. Details of management.

Income Tax

The Income Tax—An Engineer's Analysis (89285 A). Carl G. Barth. (Abstract.) 1500 w. A S M E, Jl—Oct., 1918. Mathematical investigation, with graphical representations.

Insurance

Insurance in Commerce (89512 A). W. W. Kerr. 1400 w. Aust Min Std—Aug. 29, 1918. Lecture at Melbourne, on the functions of insurance in commercial operations.

To avoid error, please order by title and number only.

Price-Fixing

Ore Advanced 25 Cents and Pig Iron $1 (89147 A). 3000 w. Iron Age—Sept. 26, 1918. Action by price-fixing conference at Washington.

Payments

Payment by Results (89329 A). D. Lyon McLarty. 3000 w. Engng—Sept. 13, 1918. Explains the premium bonus system, giving examples worked on the Rowan system, commenting on the division in labor cost effected.

Trade

Engineering Markets of the Near East (89337 A). 3500 w. Engr—Sept. 13, 1918. Information concerning trade opportunities and requirements in Greece, Turkey, Bulgaria, Servia and Roumania.

Franco - Spanish Trade Agreement (89476). 1800 w. Naut Gaz—Oct. 12, 1918. Agreement for mutual exchange of products.

Machine Tool Trade in the Scandinavian Countries After the War (89191 A). O. Ericsson. 2000 w. Machy—Oct., 1918. Opinions of interest to American machine tool builders.

Trade Acceptances

A Business Man's Views Regarding Trade Acceptances (89291). C. E. Crofoot. 3000 w. Auto Ind—Oct. 3, 1918. Advantages analyzed.

MANAGEMENT

Airplanes

Effect of Changes on Airplane Output (89686 A). 3000 w. Ind Man—Nov., 1918. Reasons why manufacturers must abandon the idea of standardized production.

Control

Graphic Production Control—III (89694 A). C. E. Knoeppel. 5000 w. Ind Man—Nov., 1918. Explanation of laws of control.

Speeding Production by Using Graphic Meters (89172) Ills. 1000 w. Elec Wld—Sept. 28, 1918. How a paper products company has installed a system of circuits which permits the management to check from the executive office any operation in the plant.

Efficiency

Efficiency and Idleness (89691 A). H. L. Gantt. 1000 w. Ind Man—Nov., 1918.

Relative Efficiency of Male and Female Operatives (89166). 4000 w. Auto Ind—Sept. 26, 1918. A study of the experiences of 127 manufacturing establishments in the metal trades.

Foremen

Instructions to Assistant Foremen (89695 A). George H. Shepard. 4500 w. Ind Man—Nov., 1918. How to treat workmen so as to produce maximum results.

Foundry Problems

Your Biggest Foundry Problem—Manpower (89224 B). H. Cole Estep. Ills. 4000 w. Fndry—Oct., 1918. More castings with less labor demanded. Machines must do the work of men. (Special number.)

Hospitals

Hospital Ornagization (89716 C). R. L. Dickinson. Ills. 9500 w. Bulletin, Taylor Society—Oct., 1917. Organization shown by charts of personnel and powers and functions.

Industrial Morale

The Need for a New Incentive for the Industrial Worker (89200). Harry Tipper. 2500 w. Auto Ind—Oct. 3, 1918. Most work lacking in requirements for effort or good work. Lessons from war.

Industrial Relations

Fundamental Factors in Sound Industrial Relations (89684 A). H. T. Walter. Ills. 3500 w. Ind Man—Nov., 1918. Facts essential to an understanding between employers and employees.

Modern Industrial Relations Department (89240 A). E. C. Gould. 1200 w. Iron Age—Oct. 3, 1918. Its organization to handle relations between employer and employees.

Labor

The Problem of Discontent (89110 A). F. B. Guthrie. 1200 w. Aust Min Std—Aug. 15, 1918. Industrial progress a factor of the welfare of the state.

The Problem of Industrial Unrest (89114 A). L. A. Adamson. 2500 w. Aust Min Std—Aug. 22, 1918. The education of the rich and its defects.

The Problem of Industrial Unrest (89111 A). H. C. Reid. 1000 w. Aust Min Std—Aug. 15, 1918. Importance of industrial and economic education.

Labor Problem

The Employer and Money (89688 A). L. L. Warren. 1200 w. Ind Man—Nov., 1918. Honest, sincere treatment more helpful than money in solving problems.

Labor Turnover

Labor Turnover—Discussion (89689 A). E. Goldberger. 1200 w. Ind Man—Nov., 1918. Details of a method applied and found satisfactory.

Mill Crews

The Morale of Mill Crews (89486 A). Paul T. Bruhl. 2000 w. Eng & Min Jl—Oct. 12, 1918. A plea on behalf of millmen. Suggestions.

Office Methods

Some Notes on Office Equipment and Methods (89441 A). C. M. Ripley. Ills. 4500 w. Gen Elec Rev—Oct., 1918. Suggestions for eliminating useless work.

Power

Mastering Power Production—X (89693 A). Walter N. Polakov. 3500 w. Ind Man—Nov., 1918. Conclusion of series. Comparison of large central stations and small isolated plants.

Service Cost

The Elimination of Office Routine (89668). E. C. Constans. 2500 w. Telephony—Oct. 26, 1918. Form in use by operating company which eliminates many useless operations.

Shipbuilding

Management — The Solution of the Shipbuilding Problem (89683 A). W. L. Churchill. 4500 w. Ind Man—Nov., 1918 A study of the work, urging the application of the principles and methods of management.

Task Work

The Human Factor in Task Setting (89685 A). W. E. Camp. 2500 w. Ind Man—Nov., 1918. Conditions that affect the human factor, showing that it is possible to pre-determine the proper allowance.

Time Studies

Organisation Scientifique De L'Usinage (89705 B). P. Denis. Ills. 4800 w. Génie Civil—Sept. 21, 1918. Serial, 1st part. Time studies for machine tools.

Wages

Equal Payment for Equal Work by Female Workers (89152 A). 1600 w. Engng—Aug. 30, 1918. Editorial discussion of piece work prices, bonus system, time rate, etc.

Supplements Affecting Wages of Signal Men (89388). 2500 w. Ry Sig Engr—Oct., 1918. Recent orders covering salary increases.

Women Workers

Putting Women Into the Machine Shop (89415 A). F. L. Prentiss. Ills. 3000 w. Iron Age—Oct. 10, 1918. Successful in Cleveland plants; qualities in which women excel.

Introducing Woman Labor Into the Shop (89647 A). M. C. Hobart. 1800 w. Am Mach—Oct. 24, 1918. Experience of the Albaugh-Dover Co. of Chicago.

Working Schedule

Working Schedule for a Time Limit Job (89697 A). Donald A. Hampson. 1000 w. Ind Man—Nov., 1918. How a medium-sized shop arranged to maintain scheduled output by good management.

REGULATION

Compensation Acts

Failure to Comply with Compensation Acts (89188 A). Chelsa. C. Sherlock. 2000 w. Machy—Oct., 1918. Results of rejection of the acts.

Control

Unified Corporate Control of the Railways After the War (89583 A). A. C. Dennis. 1500 w. Eng News-Rec—Oct. 17, 1918. Would eliminate the wastes of competition without risking the dangers of permanent Government operation.

Coöperation

The Babson Conference on Coöperation (896[illegible] A). 3500 w. Am Mach—Oct. 24, 1918. Report of the fifth annual conference of the Babson Statistical Organization at which were discussed questions concerning employer and employee.

Gear Makers decide on Closer Coöperation (89164). P. M. Heldt. 3500 w. Auto Ind—Sept. 26, 1918. Standardization plan involving all types of gears.

Employment

Public Employment Offices in the United States (89404 N). John G. Herndon, Jr. 96 pp. U S Dept Labor, Bul 241—July, 1918. A study of their methods and practices, and information concerning them.

Fuel Distribution

The "Philadelphia Plan" of Coal Allotment (89636). Jerome S. Carson. 13 pp. Ht & Vtg Mag—Oct., 1918. A highly-successful scheme of fuel distribution.

Labor

Labor Administration (89535 A). Edward T. Elbourne. 3500 w. Engr—Sept. 20, 1918. Serial, 1st part. First of a series of articles based on actual factory practice and experience.

Organization

Lay Down Lines of Organization for Contractors' Association (89250 A). 1800 w. Eng News-Rec—Oct. 3, 1918. Objects of new national body are broad in scope.

Paternalism

The Dangers of Paternalism in Government (89615 A). Otto H. Kahn. 5500 w. Eng & Min Jl—Oct. 19, 1918. Address, slightly condensed, before the convention of Am. Bankers' Assn., at Chicago, Sept. 27, 1918.

Power

See same heading under Management.

Power Law

Action Nearer on $200,000,000 Power Law (89176). 5000 w. Elec Wld—Sept. 28, 1918. Prospects of passage of measure to provide government credit for enlarging power resources.

Standardization

Gear Makers Discuss Standardization (89146 A). 4000 w. Iron Age—Sept. 26, 1918. Summary of papers at meeting of Am. Gear Mfrs. Assn. Standardization plans, committee reports, etc.

WELFARE AND SAFETY

Accident Prevention

Benefits of Accident Prevention in Contracting (89120). F. S. Robinson. Abstract of paper before the Natl. Safety Council. 1500 w. Eng & Con—Sept. 25, 1918. Account of work aiming to control accidents.

Greater Need for Accident Prevention (89145 A). 2500 w. Iron Age—Sept. 26, 1918. Summary of papers at St. Louis convention of the Natl. Safety Council on the special demand for safety campaigns.

Safety Engineering and Accident Prevention in Construction Work (89119). Leo D. Woedtke. Abstract of address before Natl. Safety Council. 4000 w. Eng & Con—Sept. 25, 1918. Suggestions for carrying out this work.

Accidents

What Each Mine Operator Can Do to Aid Accident Statistics (89218 A). A. H. Fay. 2000 w. Sfty Eng—Oct., 1918. The object of statistics, uniform records, regulations, etc.

Betterment

The Life of a Mining Community (89675 A). Charles F. Willis. Ills. 2200 w. Eng & Min Jl—Oct. 26, 1918. Efforts made by a large mining corporation to better the living and social conditions for employees.

Crippled Workers

The Reconstruction of the Crippled Soldier (89162). Douglas C. McMurtrie. Ills. 1000 w. Can Fndman—Sept., 1918. The patriotic duty of employers to study how crippled soldiers may be employed.

Rehabilitating Cripples at Ford Plant (89144 A). J. E. Mead. Ills. 2000 w. Iron Age—Sept. 26, 1918. Full efficiency attained by 85 per cent.

Fire Protection

Fire Protection in Manufacturing Plants (89286 A). Charles E. Rigby. Ills. 5000 w. A S M E, Jl—Oct., 1918. (Abstract.) Considers the construction and occupancy of buildings, the protection by automatic sprinklers and results.

First Aid

Firt Aid in the Industries (89217 A). Dr. R. L. Cameron. 1800 w. Sfty Eng—Oct., 1918. Considers proper care of injuries and also the humanitarian side of the work.

Flying Objects

Injury from Flying Objects (89244 A). Chesla C. Sherlock. 3000 w. Am Mach—Oct. 3, 1918. Legal aspects discussed.

Flywheels

Disastrous Flywheel Explosion at Chicago (89302). Ills. 1200 w. Power—Oct. 8, 1918. Account of the explosion on Sept. 19. in engine room of Chicago Coated Board Co.

Grinding Wheels

Bursting Grinding Wheels (89646 A). Chesla C. Sherlock. 2500 w. Am Mach—Oct. 24, 1918. Examples of numerous cases and court decisions as to employer's and owner's liability.

Hospitals

See same heading under Management.

Industrial Hazards

Hazards in Connection With the Reaming and Riveting of Steel Cars (89214 A). Harry Guilbert. Ills. 1000 w. Sfty Eng—Oct., 1918. Calls attention to common hazards and the way to avoid them.

Industrial Health

Industrial Hospitals and Dispensaries (89216 A). Dr. T. R. Crowder. 1200 w. Sfty Eng—Oct., 1918. As a means of conserving the health of industrial workers.

Industrial Housing

See same heading under CIVIL ENGINEERING, *Construction.*

Mine Accidents

Recording Accidents in Mines (89616 A). Albert H. Fay. 1800 w. Eng & Min Jl—Oct. 19, 1918. Need for accurate statistical reports. Examples of tabular summaries given.

Mine Safety

Mine Safety in Wartime (89258). D. Harrington. 3500 w. Cl Age—Oct. 3, 1918. Reviews the present conditions and gives suggestions.

Protective Devices

Notes on the Action of Automatic Protective Gear on a Large A. C. Net-Work (89522 A). C. W. Marshall. 1200 w. Elec Rev—Sept. 20, 1918. Outlines devices used and results.

Rescue Apparatus

Mine Rescue Apparatus (89340 A). Ills. 2000 w. Engr—Sept. 13, 1918. Report of committee appointed by the Advisory Council for Scientific and Industrial Research on investigation of types used in coal mines.

Mine Rescue Apparatus Research Committee: First Report (89198 A). Also editorial. Map. 6500 w. Colly Gdn—Sept. 13 1918. Serial, 1st part. Recommendations regarding rescue apparatus in mines.

Safeguards

Built-In Guards for Machinery (89563 A). John R. Brownell. Ills. 1200 w. Met Trds—Oct., 1918. Importance of having safety devices made an integral part of the machinery.

Mechanical Safeguards (89215 A). David S. Beyer. 4500 w. Sfty Eng—Oct., 1918. Progress in the development of mechanical guards, their value and importance.

Safety Engineers

Duties of the Safety Engineer (89220 A). David Van Schaack. 2500 w. Sfty Eng—Oct., 1918. Safe-guarding and education; getting results; personal qualifications.

Safety Work

Safety Council Discusses Conservation of Man Power (89168). 3500 w. Ry Age—Sept. 27, 1918. Unification of safety work under federal control.

Stonecutters

Effect of the Air Hammer on the Hands of Stonecutters (89610 N). Ills. 142 pp. U S Dept Labor, No 236—July, 1918. Reports of studies as to the detrimental effects upon the health.

Tools

Dangerous Tools and Appliances (89588 A). Chesla C. Sherlock. 2500 w. Am Mach—Oct. 17, 1918. Explains some of the liabilities of employers for accidents due to defective tools.

MISCELLANY

China

British Engineering Enterprises in China (89150 A). 3000 w. Engng—Aug. 30, 1918. Considers the adverse influences that have crippled British engineering enterprises.

Commerce

Commerce as a National Service (89555 A). 2200 w. Aust Min Std—Sept. 5, 1918. Digest of lecture by W. L. Raws, in Melbourne.

Germany

What Is Germany Preparing to Do After the War? (89246 A). 4000 w. Am Mach—Oct. 3, 1918. Outline Germany's postwar plans as prepared by the Guarantee Trust Co., New York.

Milwaukee

Shops Proclaim City's Resources (89279). Ills. 3000 w. Ir Trd Rev—Oct. 3, 1918. Reviews the metal working and machinery industries.

True Spirit of War Permeates Industries of Milwaukee (89276). G. H. Manlove. Ills. 2500 w. Ir Trd Rev—Oct. 3, 1918. Industrial power consecrated to the country.

Post-War

Post-War Problems (89511 A). G. S. Beeby. 1500 w. Aust Min Std—Aug. 29, 1918. Serial, 1st part. Problems affecting capital and labor, especially conditions in Australia.

U. S. Industries

The Part the United States Industries Must Perform to Enable the Allies to Win the War (89457 N). C. G. Schluederberg. 9 pp. Am El Chem Soc—Oct., 1918. Reviews particularly the electrochemical industries and their application to war work.

MECHANICAL ENGINEERING

AERONAUTICS

Air Fighting

Tricks and Acrobatics in Air Fighting (89624). From *Sci Am.* Ills. 1400 w. Com Air Mag—Oct., 1918. Describes in detail stunts useful in aerial combat.

Airplanes

Airplane Performance Determined by Engine Performance (89310 B). G. B. Upton. 3500 w. S A E, Jl—Oct., 1918. Shows the general nature and approximate numerical value of the effects of altitude on the performance of airplanes and airplane engines.

The Theoretical Basis of Model Strength Tests for Aeroplane Structures (89603). W. L. Cowley and H. Levy. 3000 w. A A Wkly—Oct. 21, 1918. Application of the principle of homogeneity of dimensions to the problem.

Biplanes

The A. E. G. Armored Biplane (89335 A). Ills. 1500 w. Engr—Sept. 6, 1918. Designed for carrying out offensive patrols againts infantry. Leading particulars and detailed description.

The Hannoveraner Biplane (89341 A). Ills. 2000 w. Engr—Sept. 13, 1918. Details of this German machine.

The Rumpler Two-Seater Biplane (89538 A). Ills. 2000 w. Engr—Sept. 20, 1918. Information concerning its construction and performance.

Engines

The 300 H. P. Mayback Aero-Engine (89151 A). Ills & Plate. 3000 w. Engng—Aug. 30, 1918. Serial, 1st part. Particulars of the 300 h. p. engines fitted by the Germans to Rumpler biplanes.

German Aviation

Évolution De L'Aviation Allemande (89718 B). J. A. Lefranc. Ills. 4800 w. La Nature—Sept. 21, 1918. Photographic apparatus employed by German aviators.

To avoid error, please order by title and number only.

Ignition

Airplane Motor-Ignition System (89589 A). B. Z. Reiter. Ills. 4500 w. Am Mach—Oct. 17, 1918. Systems are explained in detail.

Panhard Motor

The Panhard—300 H. P. (Direct Type Aviation Motor) (89601). E. H. Shermondy. Ills. 1000 w. A A Wkly—Oct. 21, 1918. Motor designated as (V-12-J) and comprised of 12 cylinders, is described.

Photography

See German Aviation.

Training Tractor

The Continental KB—3T Training Tractor (89602). Ills. 800 w. A A Wkly—Oct. 21, 1918. Designed to produce a machine that could be cheaply built.

AUTOMOBILES

Antifreezing Solutions

Antifreezing Solutions for Automobile Radiators (89311 B). 1000 w. S A E, Jl—Oct., 1918. Conclusions from investigations made by the U. S. Bureau of Standards.

Car Drivers

The Wrens and their Work (89521 A). Ills. 2000 w. Autocar—Sept. 21, 1918. Details concerning the qualifications and duties of the car driver "ratings" in the Women's Royal Naval Service.

Inspection

Factory Inspection (89308 B). Walter C. Keys, with discussion. 3500 w. S A E, Jl—Oct., 1918. As applied to manufacturing and particularly to the automotive industries.

Loading Methods

Proper Methods of Loading Automobiles (89632). Ills. 3000 w. Ry Rev—Oct. 19, 1918. Analysis of methods employed by shippers and a representative railroad.

Magnetos

Ignition Magneto Construction (89307 B). H. R. Van Deventer. Ills. 4500 w. S A E, Jl—Oct., 1918. Types and testing methods. Mechanical defects cause the largest part of magneto troubles.

Motor Fuel

A Heavy Oil Burning Arrangement for Motor Cars (89342 A). Ills. 1500 w. Engr—Sept. 13, 1918. An arrangement designed to burn tar oil on a touring car. The operation and cost.

Liquid Fuel from Coal (89326 A). W. R. Ormandy. 1700 w. Autocar—Sept 14, 1918. Shows how the final report of the Coal Conservation Committee is of direct interest to motor car users. Interrelation of pig iron, coke, and benzole.

Selling

Analysis of Automobile Merchandizing in New Zealand (89289). G. A. Worrall. Ills. 2500 w. Auto Ind—Oct. 3, 1918. Serial, 1st part. Effects from the advent of American cars in 1915 and 1916. Possibilities of the wool industry.

Tanks

The Forerunner of the Tank (89418 A). H. H. Manchester. Ills. 1500 w. Am Mach—Oct. 10, 1918. Describes some of the early forms of vehicles of similar character used over 20,000 years ago.

Tractors

Industrial Tractors for Solving Freight Terminal Congestion (89514). Ills. 1800 w. Elec Rev, Chi—Oct. 12, 1918. Benefits from substituting mechanical for manual methods for handling frieght.

Manufacturing the Caterpillar Tractor (89642 A). Frank A. Stanley. Ills. 1200 w. Am Mach—Oct. 24, 1918. Serial, 1st part. Some of the important shop processes of manufacturing this machine.

The Belt-Rail Creeper Tractor (89292). Ills. 1000 w. Auto Ind—Oct. 3, 1918. A machine differing in its creeper action, manufactured at St. Paul, Minn.

Tractor Experiences in Illinois (89309 B). Arnold P. Yerkes and L. M. Church. 6500 w. S A E, Jl—Oct., 1918. Extracts from Farmers' Bul. 963, U. S. Dept. Agri. Discusses advantages and disadvantages, size of machine required, cost, length of life, etc.

Useful Data from Harrisburg Tests (89165). 2500 w. Auto Ind—Sept. 26, 1918. Tractor demonstration gives valuable performance information.

Trucking

Motor Trucks and Buses Solve Problem of Transportation of War Industries Plants (89660). Ills. 1200 w. Mfrs Rec—Oct. 24, 1918. Account of work accomplished.

COMBUSTION MOTORS

Cooling

New Method of Cooling Gas Engines (89493). 2000 w. Pwr Pt Eng—Oct. 15, 1918. Method of internal injection of water.

Engines

The Increasing of Power Output (89275). Emil Schimanek. Ills. 4000 w. A A Wkly—Oct. 7, 1918. Ways of increasing output, including reference to a 6-stroke engine.

Marine Engines

Motori A Combustione Marini A Due Ed A Quattro Tempi (89713 C + D). G. Chiesa. Ills. 4400 w. Rivista Marittima—Aug., 1918. Two and four-stroke cycle motors for marine service.

Internal-Combustion Engines for Submarines and Aircraft (89532 A). 1800 w. Engng—Sept. 20, 1918. Editorial on points of difference in regard to weight per unit of power.

Thermodynamics

Thermodynamic Cycles in Internal Combustion Engines (89148). William J. Walker. Ills. 3500 w. A A Wkly—Sept. 30, 1918. With particular reference to aircraft requirements. Methods by which increase of power may be obtained.

HEATING AND COOLING

Heat Control

Report on Automatic Heat Control (89690 A). 500 w. Ind Man—Nov., 1918. Report of the Committee of Am. Soc. of Heating and Ventilating Engineers.

Heat Transmission

New Heat Transmission Tables (89638). William R. Jones. 5 pp. Ht & Vtg Mag—Oct., 1918. Serial, 1st part. A remarkable compilation of factors as given by leading authorities covering latest types of construction.

Hot-Water Heating

Standards of Central Station Hot Water Heating Service (89637). 2500 w. Ht & Vtg Mag—Oct., 1918. Esetablished by the Public Service Commission of Indiana under date of Aug. 3, 1918.

Refrigeration

Refrigeration in the Packing House Industry (89385). W. F. Sutherland. Ills. 2000 w. Pr House—Sept., 1918. New equipment aids in economical handling of products.

Refrigerating Plant, Intermediate Depot for American Army in France (89,664). Robert K. Tomlin, Jr. Ills. 1500 w. Power—Oct. 22, 1918. Plant built by army men to care for the storage of 5000 tons of meat.

Throttling of Ammonia (89305). Charles H. Herter. 1000 w. Power—Oct. 8, 1918. Concludes that intermediate throttling of liquid is proper under certain conditions.

Ventilation

A Ventilation Paradox (89639). Thomas R. Wilson. Ills. 1200 w. Ht & Vtg Mag—Oct., 1918. Serial, 1st part. The use of air from Chicago's freight tunnel as a refrigerating agent and fuel conserver.

The Movement to Eliminate Mechanical Ventilation in New York City's Public Schools (89640). 1500 w. Ht & Vtg Mag—Oct., 1918. Action taken by the N. Y. City Dept. of Health based upon classroom tests in twelve school buildings.

MACHINE ELEMENTS AND DESIGN

Bearings

Roller Bearings for Machine Shop Equipment (89189 A). Edward K. Hammond. Ills. 6000 w. Machy—Oct., 1918. Serial, 1st part. Fourth of a series of articles on bearings.

Drafting

Relation Between Force, Energy and Work (89644 A). Dexter S. Kimball. 1200 w. Am Mach—Oct. 24, 1918. Discusses problems of design making use of a flywheel as a concrete example.

Gears

See Standardization under INDUSTRIAL MANAGEMENT, *Regulation.*

Gear Shapers

Generating Cones and Irregular-Shaped Work (89641 A). Douglas P. Hamilton. Ills. 1500 w. Am Mach—Oct. 24, 1918. Outlines the possibilities of the gear-shaping machine.

Machinery Arrangements

Machinery and Pipe Arrangements (89,578 A). C. C. Pounder. Ills. 1500 w. Mech Wld—Aug. 23, 1918. Serial, 1st part. Diagrammatic arrangements are shown and discussed.

Pinions

Electric-Railway Motor Pinion Making (89417 A). Ills. 1000 w. Am Mach—Oct. 10, 1918. Details of methods used.

Sprockets

Sprocket Design—Theory and Practice (89193 A). Wiley M. Free. Ills. 3500 w. Machy—Oct., 1918. Factor controlling designing of sprockets for malleable chain drives, and action of chain under different conditions.

MACHINE WORKS AND FOUNDRIES

Artificial Limbs

The Manufacture of Artificial Limbs at Messrs. Yarrow's Works (89536 A). Ills. 2200 w. Engr—Sept. 20, 1918. The designs and methods used and development of the work.

Bronze

Aluminum Bronze as an Engineering Material (89192 A). 2500 w. Machy—Oct., 1918. Difficulties in casting, use and characteristics, composition, etc.

Chains

The Manufacture of Diamond Transmission Chain (89416 A). J. V. Hunter. Ills. 2000 w. Am Mach—Oct. 10, 1918. Describes some of the automatic and semi-automatic machines used.

Chisels

The Cold Chisel (89605). J. A. Lucas. Ills. 2500 w. Cl Age—Oct. 7, 1918. Difference of types and how to determine the kind to use on a certain job.

Driving Boxes

Machining Locomotive Driving Boxes (89448 A). Frank A. Stanley. Ills. 700 w. Ry Mech Engr—Oct., 1918. Outlines work at Sacramento, Cal., shops of the So. Pacific.

Foundry Industry

Foundry Industry Makes Big Gain in Two Years (89226 B). Maps. 3000 w. Fndry—Oct., 1918. Increase and development. (Special number.)

Foundry Report

The Foundry Report an Important Matter (89158). D. S. Mann. 400 w. Can Fndman—Sept., 1918. Cost of each heat is carefully kept, so that correct costs of castings may be determined.

Foundries

American and Foreign Steel Foundries (89238 A). Ernest F. Lange, in *Ir & Cl Trds Rev.* (Abstract.) 2500 w. Iron Age—Oct. 3, 1918. A British comparison of French, Belgian and American steel castings. United States molding and annealing called inferior.

Milwaukee Foundries Serve All Industry (89277). D. M. Avey. Ills. 3000 w. Ir Trd Rev—Oct. 3, 1918. Response to war demands.

Saving Man Power in the Foundry (89468). E. S. Carman. Read before Am. Fndmen's Assn. Ills. 2500 w. Ir Trd Rev—Oct. 10, 1918. Explains advantages of machine molding.

The Chemist and Metallurgist in the Foundry (89159). F. E. Gardiner. Ills. 5000 w. Can Fndman—Sept., 1918. Skilled supervision of all processes now recognized as necessary.

Furnaces

Furnaces for Open Annealing (89200 A). Walter J. May. Ills. 3000 w. Mech Wld—Sept. 6, 1918. Considers types, their chief features and management.

Grenades

Grenades for Our Army in France (89194 A). Ills. 1200 w. Machy—Oct., 1918. Information authorized by the U. S. War Department relating to the hand and rifle grenades used by the Army.

Guns

The Development of Gun Manufacture (89419 A). W. H. W. Skerrett. Ills. 4500 w. Am Mach—Oct. 10, 1918. Reviews the construction and manufacture of guns from the earliest times to the present.

Lathe

Simplified Lathe Adapted to Shell Work (89561 A). Ills. 1200 w. Iron Age—Oct. 17, 1918. Details of the Gisholt 16 and 25 in. simplified lathes.

Machine Tables

Fixing-Up Work on Machine Tables (89527 A). Joseph Horner. Ills. 1800 w. Mech Wld—Sept. 20, 1918. Serial, 1st part. Principles underlying the general practice.

Machine Tools

New French Regulations Regarding Machine Tools (89245 A). 1500 w. Am Mach—Oct. 3, 1918. Rules decreed.

Mandrels

Mandrel Work (89199 A). Joseph Horner. Ills. 2000 w. Mech Wld—Sept. 6, 1918. Designs of mandrels and their use.

Maximiller

The Kempsmith "Maximiller" (89241 A). Ills. 4000 w. Am Mach—Oct. 3, 1918. Interesting features of a recently built powerful machine.

Molding

Computing the Momentum of Melted Iron Entering Mold (89157). A. M. Older. Ills. 500 w. Can Fndman—Sept., 1918. Suggestions for molders.

Different Methods of Molding Large Kettles (89155). B. Frell. Ills. 2500 w. Can Fndman—Sept., 1918. Detailed description of satisfactory work after failure.

How Brass Carburetors Are Molded and Cast (89228 B). Ills. 3000 w. Fndry—Oct., 1918. Molding machines of the jar-ram squeeze type are employed; workmen held responsible for quality.

Mounting Pattern on Plates an Aid to Molding (89225 B). R. R. Clarke. Ills. 5000 w. Fndry—Oct., 1918. Methods described and their advantages and disadvantages discussed. (Special number.)

Patterns

The Making of Better Patterns (89,243 A). Ellsworth Sheldon. Ills. 2000 w. Am Mach—Oct. 3, 1918. Details of some of the patterns and methods of a successful shop.

Picture Machines

Making a Moving Picture Machine (89421 A). M. E. Hoag. Ills. 1500 w. Am Mach—Oct. 10, 1918. Serial, 1st part. Manufacturing methods used by the Victor Animatograph Co.

Piston Rings

Casting Rings in Centrifugal Machine (89237 A). E. F. Cone. Ills. 3500 w. Iron Age—Oct. 3, 1918. Details of De Lavaud process, which gives large production and exceptional quality.

Projectiles

Making Semi-Steel Projectiles (89413 A). Ills. 4500 w. Iron Age—Oct. 10, 1918. Method of molding, including core making and of machining.

Shells

Machining and Gaging 9.2-inch High-Explosive Howitzer Shells (89190 A). M. H. Potter. Ills. 3500 w. Machy—Oct., 1918. Machines and tools used, successive order of machining operations and complete gaging equipment.

Shell Base-Cover Assembling Die and Press (89187 A). P. H. White. Ills. 700 w. Machy—Oct., 1918. Detailed description.

Shop Practice

New Devices in Soo Wheel Shop (89,449 A). Ills. 500 w. Ry Mech Engr—Oct., 1918. Shifting platform at press and automatic discharging axle carrier add to efficiency.

Shops

Increases Strip Steel Capacity (89650). Ills. 2000 w. Ir Trd Rev—Oct. 24, 1918. Detailed description of plant of the Weirton Steel Co., Weirton, W. Va.

Skimming Gates

Various Types of Skimming Gates Used for Different Work (89156). Ills. 700 w. Can Fndman—Sept., 1918. Describes types, favoring the whirl gate.

Welding

Oxy-Acetylene Welding (89622 B). George B Malone. Ills. 11 pp. Prof Mem—Sept.-Oct., 1918. As taught at the engineering school, Washington Barracks.

Wire

Designing Passes for Wire Rod Mill Roll Train (89242 A). W. S. Standiford. 3800 w. Am Mach—Oct. 3, 1918. Design of the passes and the difficulties encountered.

MATERIALS OF CONSTRUCTION

Acetic Acid

Industrial Developments Relating to the Manufacture of Acetic Acid and Acetone (89356 A). Harold Hibbert. Ills. 3000 w. Chem & Met Eng—Sept. 25, 1918. Demand for explosives led to production from molasses, alcohol, and from calcium carbide.

Alcohol

Alcohol in the Arts and Industries (89321 A). E. H. Leslie. 2500 w. Chem & Met Eng—Oct. 1, 1918. A review of its wide use.

Alloys

The Formation of Graphite in the Iron-Carbon Series of Alloys (89149 A). J. E. Hurst. Ills. 2500 w. Engng—Aug. 30, 1918. Results of investigations.

The Relative Corrosion of Alloys (89283 A). R. B. Fehr. 2500 w. A S M E, Jl—Oct., 1918. Methods previously employed for corrosion tests and a proposed method for indicating relative corrodibility.

Ulco Hard Metal (89382 A). Francis C. Frary and Sterling N. Temple. 1500 w. Chem & Met Eng—Sept. 28, 1918. Alloy developed by the United Lead Co., its test, characteristics, uses, etc.

Bearing Metals

Conservation of Tin in Bronze Bearing Metals (89648 A). G. H. Clamer. Extract from paper read before Inst. of Metals Div. of A. I. M. E., Milwaukee, Oct. 9, 1918. 2500 w. Am Mach—Oct. 24, 1918. Explains how this unnecessary use of tin invloves waste.

Cement

Recent Developments in the Cement Industry (89370 A). Richard K. Meade. Ills. 3500 w. Chem & Met Eng—Sept. 27, 1918. Economies effected in fuel and labor, and recovery of potash.

Ceramics

Chemical Stoneware (89374 A). A. Malinovszky. Read before Am. Inst. of Chem. Engrs. 3000 w. Chem & Met Eng—Sept. 27, 1918. Preparation and selection of materials, acid-resisting tests, and annealing ware.

Recent Developments in Ceramics (89369 A). A. V. Bleininger. 3000 w. Chem & Met Eng—Sept. 27, 1918. Development of porcelain and chemical stoneware industries.

The Chemical Stoneware Industry and the War (89371 A). Percy C. Kingsbury. 2500 w. Chem & Met Eng—Sept. 27, 1918. Expansion of the American industry. Domestic materials equal to imported.

Ferro-Alloys

The Ferro-Alloys (89376 A). J. W. Richards. 4000 w. Chem & Met Eng—Sept. 28, 1918. Brief description of the manufacture, properties, and uses of the alloys of iron with manganese, silicon, aluminum, chromium, tungsten, molybdenum, vanadium, titanium, boron, and uranium.

Glass

Home Made Optical Glass (89372 A). H. E. Howe. 4000 w. Chem & Met Eng—Sept. 27, 1918. Growth of the American industry in the past four years.

Industrial Glassware (89373 A). S. R. Scholes. 1500 w. Chem & Met Eng—Sept. 27, 1918. American manufacture stimulated by war conditions.

Gun-Metal

Admiralty Gun-Metal (89534 A). F. Johnson. Read before the Inst. of Metals. 3500 w. Engng—Sept. 20, 1918. The influence of impurities on the mechanical properties.

Hardness

Hardness of Soft Iron and Copper Compared (89434 A). F. C. Kelley. Ills. 900 w. Gen Elec Rev—Oct., 1918. Experiments showing that by the electric furnace iron can be annealed to such a degree of softness as to permit its being substituted for copper in many cases of industrial use.

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Leather

The Australian Leather Industry (89113 A). C. T. Stephenson. Ills. 3000 w. Aust Min Std—Aug. 22, 1918. Description of sole leather manufacture in Australian tannery.

Metals

Grain Growth in Metals (89533 A). Zay Jeffries. Read before Inst. of Metals. Ills. & Plates. 4500 w. Engng—Sept. 20, 1918. Serial, 1st part. A study of the general laws of grain growth.

Nitric Acid

Development in Nitric Acid Manufacture in the United States Since 1914 (89355 A). E. J. Pranke. 1800 w. Chem & Met Eng—Sept. 25, 1918. Nine-fold increase in production.

Refractories

Carborundum Refractories (89375 A). S. C. Linbarger. 3000 w. Chem & Met Eng—Sept. 27, 1918. Comparative account of silicon carbide refractories with those in general use.

Relative Volatilities of Refractory Materials (89450 N). William Roy Mott. 34 pp. Am Chem Soc—Oct., 1918. A study of the order in which substances volatilize in the electric arc, and the distances at which their vapors condense from the arc.

Rare-Earth Industry

The American Pyrophoric-Alloy Industry (89378 A). Alcan Hirsch. 2500 w. Chem & Met Eng—Sept. 28, 1918. Development of the rare-earth industry in connection with Welsbach mantles.

Standardization

Report of the Committee on Standardization of Flanges and Pipe Fittings (89288 A). Ills. & Tables. 500 w. A S M E, Jl—Oct., 1918. Recommendations outlined.

Stellite

The Development of Stellite (89414 A). Elwood Haynes. Ills. 1200 w. Iron Age—Oct. 10, 1918. Melting problems solved by Snyder electric furnaces.

Sulphuric Acid

Large-Scale Sulphuric Acid Manufacture (89357 A). Andrew M. Fairlie. Ills. 4500 w. Chem & Met Eng—Sept. 25, 1918. Plant of the Tenn. Copper Co. Noteworthy features of this largest plant in the world.

MEASUREMENT

Aeroplanes

L'Essai Des Matériaux Servant à La Construction des Aéroplanes (89701 B). Ills. 3600 w. Génie Civil—Sept. 7, 1918. Testing devices and machines for aeroplane parts.

Gaging

Developing a Gaging System for Small Arms and Heavy Ordnance (89185 A). Erik Oberg. Ills. 12500 w. Machy—Oct., 1918. Serial, 1st part. Principles involved and procedure followed in system for interchangeable manufacture.

Hardness

Report on Hardness Testing: Relation Between Ball Hardness and Scleroscope Hardness (89551 N). A. F. Shore, with introduction and comments by Sir Robert Hadfield. Ills. 16 pp. Ir & St. Inst Sept., 1918.

Impact

Impact Testing (89508 A). E. P. Gooch. Ills. 1800 w. Elec Jl—Oct., 1918. Details of a testing machine and the work done with it, discussing results.

The Resistance of Metals to Penetration Under Impact (89331 A). C. A. Edwards. Read before the British Inst. of Metals. Ills. 4500 w. Engng—Sept. 13, 1918. Including a note on the hardness of solids.

Photomicrography

Note on a Telescopic Focussing Apparatus for Photomicrography (89544 N). A. F. Hallimond. Ills. 500 w. Ir & St Inst—Sept., 1918. Constructional details.

Refractories

The Standardization of Tests for Refractory Materials (89548 N). Cosmo Johns. Ills. 32 pp. Ir & St Inst—Sept., 1918. Report of Committee of the Ceramic Society, with introductory remarks.

Screw Efficiency

Efficiency of the Screw (89658 B). Benjamin F. Groat. 53 pp. Engrs' Soc W. Penn, Pro—June, 1918. Tables and diagrams for making quick calculations of the performance of screws, and examples illustrating their use.

Shaft Speeds

Critical Speeds of Shafts (89580 A). G. Bonner. 1200 w. Mech Wld—Sept. 13, 1918. Serial, 1st part. Deals with methods of calculating the critical speed.

Torsion

Torsional Stresses (89186 A). F. W. Salmon. 300 w. Machy—Oct., 1918. Table for use in machine designing, with explanation.

POWER AND TRANSMISSION

Canada

Power—Canada's Opportunity (89270). A. M. Beale. 2500 w. Can Engr—Oct. 3, 1918. Industry requires power. What other countries are doing.

Compressed Air

Hog Island Compressed Air Installation (89623). Ills. 1000 w. Com Air Mag—Oct., 1918. Detailed description.

Energy

The Waste of Energy (89554 A). H. J. Spencer. 800 w. Aust Min Std—Sept. 5, 1918. Serial, 1st part. Causes of waste and methods of effecting improvement.

Operation Records

Power Plant Records of Operation (89,184). Ralph E. Turner. 2500 w. Pwr Pt Eng—Oct. 1, 1918. Report sheets designed to aid the engineer in obtaining highest efficiency.

Power

Conditions in the Power Industry (89,230). L. W. Schmidt. 3000 w. Power—Oct. 1, 1918. Digest of reports of U. S. Consuls on the power situation in various parts of the world, and the influence of the war.

Steam Hammer

A Large Steam Driven Drop Hammer (89336 A). Ills. 400 w. Engr—Sept. 6, 1918. Brief description.

Vibration

Prevention of Vibration in Power and Ventilating Plants (89182). Charles L. Hubbard. Ills. 3000 w. Pwr Pt Eng—Oct. 1, 1918. Causes of vibration and ways of preventing communication to building.

Water Power

Comment S'Est Fait L'Aménagement Des Chutes D'Eau (89709 B). J. T. Laspière. Ills. 6000 w. Génie Civil—Oct. 5, 1918. How French water powers are administered and utilized.

Fundamental Principles in the Development of Water Power (89517). David R. Shearer. Ills. 1500 w. Power—Oct. 15, 1918. Points to be considered, explaining the calculation of flow, theoretical horsepower, and the causes of variation of stream flow.

Windmills

Some Long Island Windmills (89500 A). Edward P. Buffet. Ills. 2000 w. Am Mach—Oct. 17, 1918. Details of mechanical features of several historical windmills.

STEAM ENGINEERING

Combustion

Low-Rate Combustion in Fuel Beds of Hand-Fired Furnaces (89635). Henry Kreisinger, C. E. Augustine and S. H. Katz. Ills. 43 pp. U S Bur Mines—Tech paper 139. Description and results of a series of tests made in an experimental hand fired furnace.

Combustion Control

Power Plant Management; Control of Combustion Losses (89386). Robert June. Third article of a series. 2500 w. Pr House—Sept., 1918. Economical use of fuel to minimize the inevitable coal shortage.

Condensers

Keeping Condenser Performance Up to the Mark (89609). Hartley LeH. Smith. 2500 w. Elec Ry Jl—Oct. 19, 1918. How to determine the economy and how to correct causes of low vacuum.

Exhaust Steam

Commercial Value of Exhaust Steam (89495). Frederick C. Ruck, with discussion. 4000 w. Natl Engr—Oct., 1918. Information derived from data resulting from observations and experience.

Using Exhaust Steam (89491). S. E. Balcome. Ills. 3000 w. Pwr Pt Eng—Oct. 15, 1918. Its value and use; adaptability, effect of engine, etc.

Fuel Economy

Fuel Economy Made Simple (89304). A. Bement. 2000 w. Power—Oct. 8, 1918. Maintain a hot fire and control the rate of combustion by adjustment of draft.

Fuel Economy in Hand-Fired Power Plants (89183). Abstract from Bul. of Ill. Engng. Experiment Station. 2000 w. Pwr Pt Eng—Oct. 1, 1918. On the preparation and storage of coal.

Some Factors in Fuel Economy in Boiler Plants (89287 A). Robert H. Kuss. (Abstract.) 2200 w. A S M E, Jl—Oct., 1918. Features needing consideration to secure boiler and furnace efficiency.

Fuels

Raising Steam with the Waste Products of Yesterday (89169). Ills. 4000 w. Cl Age—Oct. 10, 1918. Silt is today a valuable asset. Burned on a specially designed grate.

Heat Generation

Generation of Heat from Bituminous Coal and Its Absorption by the Steam Boiler (89496). Henry Misostow, with discussion. Ills. 4500 w. Natl Engr—Oct., 1918. Actual and apparent efficiencies.

Oil Fuel

Efficiency in the Use of Oil Fuel (89,586). J. M. Wadsworth. Ills. 75 pp. U S Bur Mines—Aug., 1918. A handbook for boiler-plant and locomotive engineers. Aims to eliminate waste.

Steam Plant

Cedar Rapids Big Steam Plant (89,229). Ills. 4000 w. Power—Oct. 1, 1918. Plant of the Iowa Ry. & Light Co. Services cover a territory about 200 miles long and 75 miles wide.

Steam Turbines

Steam Turbine Development and Tendencies (89630). Ills. 2200 w. Elec Rev, Chi—Oct. 19, 1918. Gradual refinements affecting economy, reliability, safety and increased capacity taking place.

Additional Power by Using Low-Pressure Turbine (89306). Ills. 1200 w. Power—Oct. 8, 1918. Electric power is not always available, and the installation of a turbine with speed-reducing gears is a solution of the problem.

Superheaters

Superheater Unit Maintenance (89209). 1200 w. Ry Rev—Sept. 28, 1918. Instructions for installation and care.

Vertical Engines.

Bijdrage tot de Constructie Van Zuinige Verticale Stoomwerktuigen (89711 B). G. Brouwer. Ills. 4600 w. Ingenieur—Aug. 3, 1918. Serial, 1st part. Description.

Waste Gases

Use of Waste Gases for Steam Generation (89124). J. B. C. Kershaw. 3500 w. Cl Age—Sept. 26, 1918. Economies, etc.

Waste Heat

The Utilization of Waste Heat from Open-Hearth Furnaces for the Generation of Steam (89549 N). Thomas B. Mackenzie. Ills. 24 pp. Ir & St Inst—Sept., 1918. Tests described and results in practice given.

The Utilization of Waste Heat from Open-Hearth Furnaces for the Generation of Steam (89202 A). Thomas B. Mackenzie. Ills. 6500 w. Ir & Cl Trds Rev —Sept. 13, 1918. Details of installations and experimental data.

Water-Tubes

Renewing Tubes, Headers and Baffles in Water-Tube Boilers (89663). Ills. 5000 w. Power—Oct. 22, 1918. Detailed directions for the work.

TRANSPORTING AND CONVEYING

Grain Handling

Grain Handling Plant (89537 A). Ills. 1500 w. Engr—Sept. 20, 1918. A recent installation of large capacity at Manchester, England, is described in detail.

ELECTRICAL ENGINEERING

COMMUNICATION

Automatic System

The First Automatic Installation (89171). 700 w. Ills. Telephony—Sept. 28, 1918. Describes the earliest automatic telephone system, installed in La Porte, Ind., 25 years ago.

Compensation Agreement

Sample Compensation Agreement (89606). 4500 w. Telephony—Oct. 19, 1918. Form of instrument providing for just compensation accepted by the Postmaster-General and one company.

Consolidation

The Los Angeles Consolidation (89293). 3000 w. Telephony—Oct. 5, 1918. Problems involved in effecting a consolidation of the automatic and manual exchanges.

Federal Control

Compensation Contracts Ratified (89477). Stanley R. Edwards. 3500 w. Telephony—Oct. 12, 1918. Details of basis of compensation regarding rental of properties during federal control.

Interference

Interference by High Power Lines (99669). H. C. Don Carlos. 2500 w. Telephony—Oct. 26, 1918. Features of value to rural telephone companies.

Orders

Issued by Postmaster General (89607). 2500 w. Telephony—Oct. 19, 1918. Compilation of all bulletins and orders issued since the government assumed control and operation of the telephone systems.

Rates

Hotel Telephone Service Rates (89478). 5000 w. Telephony—Oct. 12, 1918. Order of the Massachusetts Public Service Commission. Hotel service at regular rates.

Transposition Systems

See same heading under TRANSMISSION AND DISTRIBUTION.

Transmitters

Granular Carbon for Transmitters (89170). H. R. Van Deventer. Ills. 1500 w. Telephony—Sept. 28, 1918. Requirements as to electrodes, preparation of carbon, its handling, etc.

ELECTRO-CHEMISTRY

Alkali Works

Alkali Works for Australia (89519 A). 1800 w. Aust Min Std—Sept. 12, 1918. Chemical firms coöperate to establish industry for manufacture of caustic soda, chlorine, bleaching powder, etc.

Cells

Discharge Characteristics of a Certain Make of Dry Cell (89455 N). C. A. Gillingham. 28 pp. Am El Chem Soc—Oct., 1918. Study of 6x15 cm. cell.

Chemical Industry

Abstract of the Census of Chemical Manufactures (89354 A). 16 pp. Chem & Met Eng—Sept. 24, 1918. Comparative statistical analysis of U. S. census taken in 1909 and 1914—Production and financial data on chemical industries.

The Chemical Industry in Export Trade (89351 A). G. A. O'Reilly. 1800 w. Chem & Met Eng—Sept. 24, 1918. Essentials for success comprise finding a market, catering to its requirements, and meeting competition.

The Economic Importance of Our Chemical Industry (89352 A). Frederick A. Clawson. 5500 w. Chem & Met Eng—Sept. 24, 1918. Review showing expansion to meet war demands.

War Disturbances and Peace Readjustments in the Chemical Industries (89353 A). Grinnell Jones. 3500 w. Chem & Met Eng—Sept. 24, 1918. View of the dislocations of normal trade and industry caused by the war.

Electric Furnaces

Notes on Electric-furnace Problems (89573 D). J. L. McK. Yardley. 1400 w. A I M E, Bul—Oct., 1918. Analysis, made to determine the maximum capacity and approximate performance of a new furnace, to operate at 160 volts on a 60-cycle circuit.

Electrodes for Electric Furnaces: Their Manufacture, Properties, and Utilization (89433 A). Jean Escard. 5500 w. Gen Elec Rev—Oct., 1918. Serial, 1st part. Trans. from Le Genie Civil. Present article describes the raw materials from which electrodes are manufactured, the process, and some of the characteristics of carbon electrodes.

Electrochemistry

Electrochemistry and National Economy (89458 N). Colin G. Fink. 5 pp. Am El Chem Soc—Oct., 1918. The resources of the South and the achievements of the electrochemist.

Electrodes

Processes Within the Electrode Which Accompany the Discharge of Hydrogen and Oxygen (89451 N). Donald P. Smith. 9 pp. Am El Chem Soc—Oct., 1918. Measurements of the changes in electrical resistivity and in length by using electrodes of palladium, platinum, tantalum and iron.

Electroplating

Effecting War Economies in the Plating Room (89227 B). E. P. Slater. 4000 w. Fndry—Oct., 1918. How waste may be eliminated and metals, acids and other materials conserved. (Special number.)

Industrial Chemistry

Advance in Industrial Organic Chemistry Since the Beginning of the War (89319 A). Samuel P. Sadtler. 6000 w. Chem & Met Eng—Oct. 1, 1918. Review of expansion in America; outlook for the future encouraging.

Organic Synthesis and the du Pont Company (89322 A). C. L. Reese and C. M. Stine. 2500 w. Chem & Met Eng —Oct. 1, 1918. Evolution and growth if a varied organic chemical industry.

The Electrochemical Industries at Shawinigan Falls (89320 A). Henry C. Randall. Ills. 3000 w. Chem & Met Eng—Oct. 1, 1918. Development of over 300,000 h.p. and of varied industries.

Nitrogen

Direct and Indirect Methods of Nitrogen Fixation (89358 A). E. Kilburn Scott. 3500 w. Chem & Met Eng—Sept. 25, 1918. Comparison of operations involved.

Micro-Organisms in Plant Chemistry and Nitrogen Fixation (89323 A). Ellwood Hendrick. Ills. 2500 w. Chem & Met Eng—Oct. 1, 1918. Development and application of organizations useful to plant growth.

Nitrogen Fixation Furnaces (89456 N). E. Kilburn Scott. Ills. 32 pp. Am El Chem Soc—Oct., 1918. Reviews and compares types of furnaces, and describes in detail the Kilburn Scott three-phase furnace.

Potentials

The Sign of Potentials (89454 A). Oliver P. Watts. 7 pp. Am El Chem Soc—Oct., 1918. Historical retrospect concerning the usage of electrochemists in designating the signs of potentials, and plea made for continuing the present conventions.

ELECTRO-PHYSICS

Electrical Resistance

On the Rate of Change at 100° C. and at Ordinary Temperatures in the Electrical Resistance of Hardened Steel (89540 N). E. D. Campbell. 6 pp. Ir & St Inst—Sept., 1918. Quantitative data on the rate at which the electrical resistivity changes, indicating the influence of temperature.

Induction Coils

The Capacity—Potential Curves of an Induction Coil (89201 A). E. Taylor Jones. 2500 w. Elec'n—Aug. 30, 1918. Serial, 1st part. Experimental study.

Potentials

See same heading under Electro-Chemistry.

Radioactivity

See same heading under ILLUMINATION.

Radium

An Apparatus for the Separation of Radium Emanation and Its Determination Electroscopically (89452 N). J. E. Underwood and Herman Schlundt. Ills. 6 pp. Am El Chem Soc—Oct., 1918. Describes apparatus and method of determining radium in various ores and concentrates.

Notes on the Heterogeneous Equilibrium of Hydrogen and Oxygen Mixed with Radium Emanation (89453 N). S. C. Lind. 9 pp. Am El Chem Soc—Oct., 1918. Discussion of the catalytic effect of radium emanation on causing hydrogen and oxygen to combine.

GENERATING STATIONS

Central Stations

New Wood-Burning Station of Northwestern Electric Company (89513). Ills. 1200 w. Elec Rev, Chi—Oct. 12, 1918. Details of construction and equipment of a plant nearing completion at Portland, Ore.

The Electricity Supply of Archangel (89525 A). Ills. 2500 w. Elec Rev—Sept. 27, 1918. Description from *Elektrichestvo*.

War's Effect on Central-Station Policy (89484). Philip Cabot. 2200 w. Elec Wld—Oct. 12, 1918. Address before New England Sec. of Natl. Elec. Lgt. Assn. Opportunities for large scale development, and forecast of government ownership.

Reconstruction of a Two-Phase Station—I (89266-). Ills. 2000 w. Elec Wld—Oct. 5, 1918. Serial, 1st part. How problems made necessary by rapid load development were handled.

The Power Station at Millers Ford (89628). Ills. 2500 w. Elec Rev, Chi—Oct. 19, 1918. Features of Dayton's Power & Light Co.'s new plant.

The Millers Ford Station (89490). Ills. 3500 w. Pwr Pt Eng—Oct. 15, 1918. Interesting features of new Dayton, O., power plant.

Coal Conservation

Coal Conservation Suggestions for the Central Station Industry (89629). P. B. Noyes. 1500 w. Elec Rev, Chi—Oct. 19, 1918. Fuel administration asks Central Stations to use coal more efficiently and reduce needless energy.

Hydro-Electric

Hydro-Electric Development at Rochester (89181). Ills. 1000 w. Pwr Pt Eng—Oct. 1, 1918. Relieving peak load on steam plant; unusual system of generator protection.

New Hydroelectric Plant of Montana Power Company (89205). W. A. Scott. Ills. 2200 w. Elec Rev, Chi—Sept. 28, 1918. Serial, 1st part. The Holter project, recently completed. Details of hydraulic equipment.

Aménagement De Chutes D'Eau Dans Les Pyrénées (89704 B). Ills. 3400 w. Génie Civil—Sept. 21, 1918. Serial, 1st part. Hydro-electric installations in the Pyrenees district for supplying energy to the Southern Railway system in France.

Interruptions

Preventing Interruption of Production (89264). Sydney Fisher. 3500 w. Elec Wld—Oct. 5, 1918. What can be done to assure uninterrupted maintenance.

Loads

An Ideal Twenty-four-hour Load Now Awaiting Central Station Power (89439 A). S. G. Gassaway and W. G. Taylor. 2000 w. Gen Elec Rev—Oct., 1918. Electrification of the oil fields will give a large saving in oil.

Power Factor

Getting the Maximum Out of Equipment (89667). Will Brown. 3000 w. Elec Wld—Oct. 26, 1918. Serial, 1st part. How to improve power factor to meet the needs of the approaching winter.

Power Plant Design

Plant Designed to Meet War-Time Conditions (89482). Ills. 2500 w. Elec Wld—Oct. 12, 1918. Arrangements for burning coal, oil and wood. Electrical features.

Arrangements to Avoid Operating Difficulties—I (89611). Ills. 1500 w. Elec Wld—Oct. 19, 1918. Serial, 1st part. Attention given in the new Dayton plant to handling coal economically and obtaining clean intake water.

Plant Arrangements and Costs of Construction (89665). Ills. 2500 w. Elec Wld—Oct. 26, 1918. Serial, 1st part. Features of latest station of Turners Falls Power & Electric Co.

Substations

Outdoor Distribution Substations in War Times (89265). Ills. 800 w. Elec Wld—Oct. 5, 1918. Three-phase transformers with automatic pole-top oil switches in primary.

The Automatic Substation Has Come to Stay (89480). Walter C. Slade. 3500 w. Elec Ry Jl—Oct. 12, 1918. Outlines the present status of the automatic substation.

GENERATORS AND MOTORS

Factory Motors

Care and Operation of Electric Motors in Factories (89673). Joseph P. Collopy. Ills. 4000 w. Elec Rev, Chi—Oct. 26, 1918. Points on maintenance of direct-current, induction, and synchronous motors.

Generator Control

La Régulation Des Groupes Électrogènes (89710 B). L. Barbillion. Ills. 4000 w. Rev Générale des Sciences—Aug. 15-30, 1918. Methods of regulation employed for electric generating sets.

Induction Motors

Low Over-All Cost and Continuous Production (89174). A. P. Lewis. 2500 w. Elec Wld—Sept. 28, 1918. Factors to be considered in purchasing, installing and maintaining induction motors designed to assist in accomplishing objects named.

Motor Control

Control System for Cement-Mill Motors (89206). William H. Easton. Ills. 800 w. Elec Rev, Chi—Sept. 28, 1918. Interesting system recently installed at Siegfried, Pa., for controlling groups of large high voltage motors.

Parallel Operation

Load Division Between Synchronous Frequency Changers Operating in Parallel (89303). Quentin Graham. 1600 w. Power—Oct. 8. 1918. Serial, 1st part. Treats of the fundamental elements that must be considered.

Remote Control

The Remote Control of Motor-Driven Pumps and Compressors ((89396 A). F. M. Nourse. Ills. 1200 w. Mun Eng—Oct., 1918. Types of controlling apparatus.

Rotors

Turbo-Alternator Rotors: Features of Mechanical Design (89387). S. F. Barclay. 8000 w. Pr House—Sept., 1918. Serial, 1st part. Reviews conditions underlying the design.

Temperature Rise

Guarantees for Temperature Rise in Electrical Machinery, with Special Reference to Large Turbo-Generators (89654 N). A. E. du Pasquier, with discussion. 13 pp. So Af Instn Elec Engrs, Trans—July, 1918. Shows that a more scientific basis should be adopted and that there is no good reason for restricting temperature rise, providing suitable materials are obtainable.

ILLUMINATION

Aesthetic Lighting

Linking Science and Art in Lighting (89296). M. Luckiesh. 2500 w. Elec Rev, Chi—Oct. 5, 1918. Serial, 1st part Opportunities in æsthetic lighting, particularly for interiors, etc.

Illuminating Engineering

Illuminating Engineering as a Commercial Force (89618 C). O. R. Hogue, C. L. Law, and E. E. Whitehorne, with discussion. 10 pp. Ill Eng Soc, Trans—Oct. 10, 1918. The purposes and organization for the work, achievements and organized development.

Incandescent Lighting

Incandescent Lighting in War Time (89435 A). G. H. Stickney and T. W. Moore. Ills. 2000 w. Gen Elec Rev—Oct., 1918. Résumé of features concerning war time lighting and the value of the service.

United States Fuel Administration's Program for Abolishing Inefficient Types of Incandescent Lamps (89438 A). 2500 w. Gen Elec Rev—Oct., 1918. Saving of one million tons of coal a year estimated by substituting highly efficient lamps for the carbon and gem types.

Industrial Lighting

Artificial Daylight in the Industries (89175). M. Luckiesh. 2500 w. Elec Wld—Sept. 28, 1918. Qualifications of light required for color discrimination, with examples of daylight lamps installed.

Tendencies in Textile Mill Illumination (89437 A). A. L. Powell. Ills. 1000 w. Gen Elec Rev—Oct., 1918. High intensity needed. Excellent illumination by use of Mazda C lamps with proper reflectors.

Some Modern Methods of Lighting (89494). George H. Stickney, with discussion. Ills. 9500 w. Natl Engr—Oct., 1918. Practical suggestions on the lighting of industrial plants, office buildings and stores.

Radioactivity

Radioactive Luminous Materials (89380 A). Wallace Savage. Ills. 1500 w. Chem & Met Eng—Sept. 28, 1918. Scientific development. Recent uses, etc.

Street Lighting

Street Lighting with Reference to the Manufacturer, the Central Station, and the Municipality (89436 A). G. L. Thompson. 1500 w. Gen Elec Rev—Oct., 1918. Shows that improvement is not likely to be as great in the future as in the past.

MEASUREMENT

High Frequency

Appareils De Mesure Et D'Étude Des Courants à Haute Fréquence (89702 B). Ills. 1300 w. Génie Civil—Sept. 14, 1918. Apparatus for measurement of high frequency currents and oscillations.

POWER APPLICATIONS

Anthracite Mines

The Use of Electric Power in the Mining of Anthracite Coal (89411 D). J. B. Crane. Ills. 1000 w. A I E E, Pro—Oct., 1918. Gives power cost and current consumption in anthracite mines, and reasons for these being in excess of bituminous mines. Representative installations.

Brass Melting

The Present Status of Electric Brass Melting (89350 A). H. M. St. John. Ills. 8500 w. Chem & Met Eng—Sept. 15, 1918. Survey of the applications of electric furnaces to the melting of brass and other copper alloys.

Cottrell Processes

Cleaning Foundry Air Electrically (89,-649). H. D. Egbert. From paper read at Milwaukee meeting of Am. Fnd. Assn. Ills. 3000 w. Ir Trd Rev—Oct. 24, 1918. Foreign matter charged with static electricity and deposited on collecting electrodes.

To avoid error, please order by title and number only.

The Cottrell Processes in the Sulphuric Acid Industry (89348 A). A. A. Heimrod and H. D. Egbert. Ills. 4500 w. Chem & Met Eng—Sept. 15, 1918. Account of the successful application of electric precipitation for the removal of dust from roaster gases and acid mist from exit gases.

France

La Houille Blanche Pendant La Guerre (89724 E). H. Cahen. 7200 w. Soc Ingénieurs Civils De France—April-June, 1918. Electric power; its available amount and industrial use.

Heating Appliances

Electrically Heated Industrial Appliances and Devices (89687 A). George J. Kirkgasser. Ills. 3500 w. Ind Man—Nov., 1918. Outlines the most important applications, describing devices used.

Industry

Industrial Applications of Electricity (89483). Dwight D. Miller. Ills. 2500 w. Elec Wld—Oct. 12, 1918. Serial, 1st part. Predicts that the electric heating load will surpass the motor load.

The Electrical Industry in Russia (89,523 A). Allan Monkhouse, Jr. 3000 w. Elec Rev—Sept. 20, 1918. Reviews the advance made and the possibilities of development.

Steel Mills

Electrical Plant in Steel Works (89,492). Mark Meredith. 2000 w. Pwr Pt Eng—Oct. 15, 1918. Points to be considered in the selection of motors, controllers, and magnets.

Welding

Electric Welding—A New Industry (89410 D). H. A. Hornor. Ills. 11 pp. A I E E, Pro—Oct., 1918. Reviews the uses of electric spot and arc welding in the United States, the recent development in apparatus, and applications to heavy work.

Electric Welds (89347 A). Ernest Edgar Thum. Ills. 6000 w. Chem & Met Eng—Sept. 15, 1918. Notes on different types of electric welding machines, the properties and microscopy of the welds.

Some Notes on the Resistance Method of Electric Welding (89579 A). G. W. Stubbings. 1400 w. Mech Wld—Sept 13, 1918. Principle and its application.

TRANSMISSION AND DISTRIBUTION

Circuits

Fundamental Relations Between Direct- and Alternating-Current Circuits (89651). Terrell Croft. Ills. 2000 w. Cl Age—Oct. 24, 1918. Deals with theory.

Feeders

The Calculation of Single-Phase and Three-Phase Lines (89526 A). J. R. Dick. 1500 w. Elec'n—Sept. 20, 1918. Serial, 1st part. From forthcoming new edition of "Electric Mains and Distributing Systems." Mathematical.

Interconnection

New England—Boston Power Interconnection (89177). Map. 2000 w. Elec Wld—Sept. 28, 1918. Transmission line between the two large systems will insure 20,000 kw .for war industries.

Interior Wiring

Importance to Public of Inspection of Interior Wiring (89674). William S. Boyd. 2200 w. Elec Rev, Chi—Oct. 26, 1918. Serial, 1st part. Discusses need for electrical inspection.

Insuring Against Disagreements Over Wiring (89612). Ills. 1800 w. Elec Wld —Oct. 19, 1918. Service code established by Bridgeport (Conn.) utility.

Line Construction

Transmission-Line Construction of Duquesne Light Company (89672). Thomas R. Hay. Ills. 1800 w. Elec Rev, Chi—Oct. 26, 1918. Account of difficulties met in building a 66,000-volt line through a mountainous region.

Pole Numbering

Numbering of Pole Line Structures (89295). Ills. 1500 w. Elec Rev, Chi—Oct. 5, 1918. Comparison of various methods of numbering poles.

Relays

Time Limit Induction Overload Relay (89440 A). F. E. Jaquay. Ills. 900 w. Gen Elec Rev—Oct., 1918. Built on principle of induction type meters. Descriptive.

Transposition Systems

Design of Transpositions for Parallel Power and Telephone Circuits (89281 A). Harold S .Osborne. 3000 w. Tel Engr—Oct., 1918. Serial, 1st part. Results obtained in a recent design of transposition systems for telephone circuits exposed to induction from other circuits.

CIVIL ENGINEERING

BRIDGES

Arches

The Economics of Steel Arch Bridges (89223 D). 1200 w. A S C E, Pro—Sept., 1918. Continued discussion of J. A. L. Waddell's paper.

The Economics of Steel Arch Bridges (89656 D). 13 pp. A S C E, Pro—Oct., 1918. Continued discussion of J. A. L. Waddell's paper.

Construction

Architecture and Construction of Bridges (89596 A). Charles Evan Fowler. 10 pp. N Y Rd Cb, Pro—Sept. 20, 1918. Reviews the progress of design and the accomplishment in span girder and in suspension and arch bridges; problems of erection, loadings, etc.

Highway

Recommended Practice in Design and Construction of Permanent Highway Bridges of Concrete and Steel (89400 A). John W. Towle. 2000 w. Mun Eng—Oct., 1918. From address before N. C. Good Roads Assn. Types in use; building and maintenance.

Portland, Me.

Draw Pier of Portland Bridge Settles Three Feet (89127 A). 1200 w. Eng News-Rec—Sept. 26, 1918. Out of service temporarily by sinking of concrete pier resting on piles.

Quebec

The New Quebec Bridge (89328 A). Ills. and Plates. 4500 w. Engng—Sept. 13, 1918. Account of its erection.

CONSTRUCTION

Building Laws

Puzzling Variations in Important Building-Law Clauses (89130 A). R. Fleming. 3000 w. Eng News-Rec—Sept. 26, 1918. Requirements as to stresses; wind bracing neglected, etc.

Foundations

Sinking Six Cylinder Foundations a Day on Boston Army Supply Base (89,132 A). Ills. 2500 w. Eng News-Rec —Sept. 26, 1918. Concrete open wells of 6-ft. outside diameter, and from 33 to 55 feet deep. Careful planning and use of handling machinery gives results.

Housing

Construction Camps Model Towns on Miami Flood Works (89129 A). Ills. 2500 w. Eng News-Rec—Sept. 26, 1918. Villages of homes with all modern conveniences house workmen at the five large dams being built.

Housing at Tyrone, New Mexico (89,559 A). Charles F. Willis. Ills. 1500 w. Chem & Met Eng—Oct. 15, 1918. Account of the efforts of the Phelps Dodge Corporation to provide wholesome living conditions for its employees.

Housing Development for the Air Nitrate Corporation, Sheffield, Alabama (89,280 B). Charles C. May. Ills. 2000 w. Arch For—Sept., 1918. Details of town development.

Housing of Labor and Sanitation at Mines in India (89591 N). J. H. Evans, with discussion. 8 plates. 3000 w. Min & Geol Inst of India, Trans—April, 1918. Types designed to suit conditions in India.

Industrial Housing (89597 A). Benjamin Wilk. Ills. 11 pp. Af Eng Socs of Minn, Bul—Oct., 1918. Discusses housing and social problems of working men.

Underpinning

Altering Old Office Building Requires Heavy Underpinning (89247 A), Ills. 1600 w. Eng News-Rec—Oct. 3, 1918. Brick arch floor 60x100 ft. in area raised 3 ft. in two sections. Thick bearing wall replaced by steel framing.

IRRIGATION AND RECLAMATION

Drainage

Proposta Di Bonifica Dello Stagno Di Cagliari (89715 B). L. C. Vecchi. Ills. 5200 w. L'Industria—Aug. 15, 1918. Plan for draining the Cagliari marshes on the island of Sardinia.

Pumping

Operating Features of a California Pumping Project (89294). Ills. 1500 w. Elec Rev, Chi—Oct. 5, 1918. Terra Bella irrigation system operated entirely by motor-driven pumps.

Pumping Engines for the Cairo Main Drainage (89327 A). Ills and Plate. 2500 w. Engng—Sept. 6, 1918. Details of the mechanical equipment of the main pumping station and pumping engines.

MATERIALS OF CONSTRUCTION

Concrete Lumber

Precast Concrete Lumber Proves Successful in Mine (89252 A). Ills. 2000 w. Eng News-Rec—Oct. 3, 1918. Fire resistivity sought. Costs about twice as much as timber.

Masonry

Guatemala Earthquakes Destroyed All Masonry Buildings (89251 A). Edward Stuart. Ills. 2000 w. Eng News-Rec—Oct. 3, 1918. Wood and concrete frames stood shocks well.

Roofing

Sheet Zinc for Roofing (89274 A). W. H. Seamon. Ills. 7000 w. Eng & Min Jl—Oct. 5, 1918. Uses and details of construction.

Rubber

War Problems of the Rubber Industry (89324 A). Andrew H. King. 2000 w. Chem & Met Eng—Oct. 1, 1918. How United States manufacturers met the rubber shortage.

Salvage

Possibilities of Salvage and Utilization of Waste (89626). David Currie. 2500 w. Can Engr—Oct. 17, 1918. Address at conference of Inst. of Cleansing Supts. The urgent need and possibilities.

Timber

American Forestry Units Are Working Fifty-three Tracts of French Timber Land (89126 A). Robert K. Tomlin, Jr. Ills. 2000 w. Eng News-Rec—Sept. 26, 1918. Big organization of trained men is relieving wood shortage for army construction purposes.

Economics of Pole Timber (89173). Ernest F. Hartman. Ills. 2000 w. Elec Wld—Sept. 28, 1918. Life of poles doubled by preservative treatment.

Fungi, the Cause of Decomposition of Timber (89221 A). P. H. Dudley. Ills. 5000 w. Wood Presg—July-Sept., 1918. Brief details of the life history of trees and of fungi. Timber preservation.

Wood Waste

Manufacture of Ethyl Alcohol from Wood Waste (89334 A). 2500 w. Engr—Sept. 6, 1918. Reviews the history of past efforts and describes the present process, giving uses of ethyl alcohol.

Wood-Waste as a Source of Ethyl Alcohol (89318 A). George H. Tomlinson. 3500 w. Chem & Met Eng—Oct. 1, 1918. Technical problems solved. Costs at Fullerton, La.

MEASUREMENT

Columns

Discussion on Final Report of the Special Committee on Steel Columns and Struts (89657 D). 19 pp. A S C E, Pro—Oct., 1918. Continued discussion.

Soundings

Taking Soundings Above Niagara Falls from the Shore (89254 A). Leon R. Brown. Ills. 2500 w. Eng News-Rec—Oct. 3 ,1918. Experimenting develops effective use of triangular float and weighted pole, controlled by cables.

Stored Energy

On the Distribution of the Energy Stored in Reinforced Concrete Beams and Column-Supported, Flat-Slab Floors (89593 B). Henry T. Eddy. 9 pp. Fkn Inst, Jl—Oct., 1918. Shows the enormous difference between the storage of energy in beams and slabs, and that slabs cannot be computed by beam theory.

MUNICIPAL

City Planning

City Planning is Closely Related to Public Safety (89128 A). Thomas Adams and Harland Bartholomew. 2800 w. Eng News-Rec—Sept. 26, 1918. Extracts from paper read before Natl Safety Council. Illustrations from defective planning at St. Louis.

Garbage

Garbage Collection and Disposal Under War Conditions (89584 A). M. N. Baker. 6 pp. Eng News-Rec—Oct. 17, 1918. U. S. Food Administration makes country-wide survey. Data summarized and discussed.

Imhoff Tanks

Prevention of Imhoff Tank Foaming at Schenectady, N. Y. (89398 A). Harrison P. Eddy. 1000 w. Mun Eng—Oct., 1918. Conditions and the controlling by drawing sludge or scum.

Mosquitoes

Methods of Eradicating Mosquitoes in Malarial Control Campaign (89462). C. N. Harrub. 1800 w. Eng & Con—Oct. 9, 1918. Methods of drainage, oiling, fish control and larvacides.

Sewage Disposal

First Unit of Improved Means of Sewage Disposal for Philadelphia Well Started (89253 A). W. L. Stevenson. Ills. 3500 w. Eng News-Rec—Oct. 3, 1918. Design includes intercepting sewer, ventilated grist chamber with sand-removing and washing plant, and depressed venturi meter.

ROADS AND PAVEMENTS

Asphalt

Procedure in Maintenance of Asphalt Pavements in Buffalo (89401 A). C. E. P. Babcock, and J. A. Vandewater. 1500 w. Mun Eng—Oct., 1918. Methods, quantities, and costs.

The Asphalt Roads of Cook County, Illinois (89393 A). Walter H. Flood. 1200 w. Mun Eng—Oct., 1918. Change from macadam to concrete base; methods of construction, etc.

Drainage

Drainage Increasingly Vital with Growth of Heavy Traffic (89236). E. W. James. 3000 w. Eng & Con—Oct. 2, 1918. From official publication of U. S. Bureau of Public Roads.

Drainage—the Most Important Consideration Entering into Road Construction (89467). James H. MacDonald, with discussion. 6000 w. Can Engr—Oct. 10, 1918. Address at fifth annual congress of the Can. Good Roads Assn.

Excess Condemnation

A Review of the Movement for Excess Condemnation for Public Improvements (89234). 2500 w. Eng & Con—Oct. 2, 1918. Experience in the exercise of this power in Europe, and United States.

Highways

Notes on Highway Design (89235). J. L. Harrison. 2000 w. Eng & Con—Oct. 2, 1918. Considers railway crossings, aesthetic considerations, stream crossings, drainage, road material, etc.

Paving

Force Account Paving at St. Paul, Minn. (89232). Oscar Claussen. From paper before Engrs' Soc of St. Paul. 2000 w. Eng & Con—Oct. 2, 1918. Preparing cost estimates, and reasons for favoring day labor plan for paving.

Pavements

Proper Method of Application of Bituminous Filler for Creosoted Wood Block Pavements and Floors (89231). Lambert T. Ericson. Ills. 1000 w. Eng & Con—Oct. 2, 1918. Directions for the work.

The Choice of Fillers for Block Pavements (89395 A). John S. Crandell. Ills. 2500 w. Mun Eng—Oct., 1918. Types and functions of fillers, favoring bituminous fillers.

Repairs

Relative Efficiency of Methods for Repairing Bituminous Macadam and Bituminous Concrete Pavements (89402 A). George H. Biles. 4000 w. Mun Eng—Oct., 1918. Condensed slightly from paper before Am. Assn. for Adv. Sci., Dec. 28, 1917.

Road Construction

The Use of Modern Machinery in County Road Construction (89394 A). C. B. Scott. 1800 w. Mun Eng—Oct., 1918. From address at N. C. Good Roads Assn. Brief description of various machines and devices, and new ways in which they are used.

Road Culvert

Road Culvert Checks Destructive Storm-Water Flow (89248 A). Ills. 600 w. Eng News-Rec—Oct. 3, 1918. New design prevents erosion of ditches and farm lands.

Saskatchewan

Planning a System of Rural Highways in the Province of Saskatchewan (89269). W. M. Stewart. Read before Eng. Inst. of Can. 3000 w. Can Engr—Oct. 3, 1918. Classes of roads; knowledge necessary for development, etc.

Women Workers

Employment of Women on State Highway Construction (89233). Herbert A. Nunn. 700 w. Eng & Con—Oct. 2, 1918. Experience favorable on Oregon State Highways.

WATER SUPPLY

Aqueducts

Station Work Solves Labor Problem in Constructing Concrete Aqueduct of Winnipeg Water Supply (89461). F. P. Kemon. Ills. 2500 w. Eng & Con—Oct. 9, 1918. Details of the station work system and reasons for its adoption.

Artesian Wells

Artesian Wells for Water Supply, with Special Reference to the Artesian Wells of Wisconsin (89397 A). W. G. Kirchoffer. 2500 w. Mun Eng—Oct., 1918. Early history; the essential condition, sources, velocity of flow, etc.

Filtration

Drifting Sand Filter, Toronto Island (89661). George C. Nasmith and N. J. Howard. Ills. 2000 w. Can Engr—Oct. 24, 1918. Report as to its efficiency.

Preliminary Analysis of Degree and Nature of Bacterial Removal in Filtration Plants (89463). Abel Wolman. 1500 w. Eng & Con—Oct. 9, 1918. Abstract of paper before St. Louis Convention of Am. W-Wks. Assn.

Proposed Filter Plant for Walkerville, Ont. (89625). Ills. 1000 w. Can Engr—Oct. 17, 1918. Details of a new plant to be erected next spring.

Some Design and Construction Features of the New Slow Sand Water Filtration Plant at Auburn, New York (89399 A). J. Walter Ackerman. Ills. 1500 w. Mun Eng—Oct., 1918. Descriptive.

The Flow of Water in Wash Water Troughs for Rapid Sand Filters (89655 A). Frank V. Fields. Ills. 3000 w. Corn C E—May, 1918. Investigation to secure data on which to base the design of wash water troughs.

Reservoirs

Newton, Mass., Water-Works Reservoir (89408 B). Edwin H. Rogers. Ills. 1500 w. Bos Soc C E, Jl—Sept., 1918. Detailed description of recently completed covered reservoir.

Small Towns

Water Supplies for Small Towns (89112 A). F. R. Mahony. 1200 w. Aust Min Std—Aug. 15, 1918. Serial, 1st part. Suitable methods of providing supplies.

York Township Water Supply (89662). Ills. 1500 w. Can Engr—Oct. 24, 1918. Outline of scheme to supply a Canadian municipality with water.

Water Waste

Methods of Water Waste Elimination in a 100 Per Cent Metered City (89460) H. P. T. Matte. 2000 w. Eng & Con—Oct. 9, 1918. Abstract of paper before Ill. Sec. of Am. W.-Wks. Assn. Experience at Oak Park, Ill.

WATERWAYS AND HARBORS

American Ports

How the War Has Developed American Ports (89141 A). V. G. Iden. 2500 w. Mar Rev—Oct., 1918. Reviews developments; change in plans; docks built, etc.

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Canadian Ports

Western Ports of Canada (89268). S. McClay. Read at Boston convention of the Am. Assn. of Port Authorities. 4500 w. Can Engr—Oct. 3, 1918. Prospects for Vancouver; Prince Rupert harbor.

Canals

Welland Ship Canal (89627). J. Garnar Flood. Ills. 4000 w. Can Engr—Oct. 17, 1918. Notes on Canada's $50,000,000 waterway between lakes Erie and Ontario.

Projet De Canal Latéral A L'Allier (89706 B). Ills. 3200 w. Génie Civil—Sept. 21, 1918. History and development of project for a canal bringing traffic to the Loire river in the Allier district.

Projet De Canal De Paris A Dieppe (89708 B. Ills. 2000 w. Génie Civil—Oct. 5, 1918. Project for a canal from Paris to Dieppe, on the Channel coast.

Chile

Development of Port Chanaral, Chile (89333 A). 1200 w. Engr—Sept. 6, 1918. Details of the scheme of development of this small but favorably situated port.

Drainage

Main Drainage and Its Relation to River and Harbor Front Improvements (89267). Morris Knowles and John M. Rice. 7000 w. Can Engr—Oct. 3, 1918. Serial, 1st part. Résumé of methods adopted in many cities with notes regarding design of the Essex interceptor. Extracts from paper read before Am. Soc. Munic. Imp.

Dredging

Using Electric Power to Dredge a Relocated River Channel (89585 A). J. H. Walter. 2000 w. Eng News-Rec—Oct. 17, 1918. Suction dredge operated by 800-hp. motor.

Flood Control

Detention Reservoirs with Spillway Outlets as an Agency in Flood Control (89222 D). 2500 w. A S C E, Pro—Sept., 1918. Continued discussion of H. M. Chittenden's paper.

France

Le Réseau Navigable De La Saone (89721 C + D). M. Jacquinot. Ills. 18,000 w. Annales des Ponts et Chaussées—May-June, 1918. Navigable portion of the Saone river, and its commercial importance.

French Ports

Les Ports Français Et La Guerre (89700 B). A. Pawlowski. Ills. 3200 w. Génie Civil—Sept. 7, 1918. Port of Dakar, French West Africa. Docks and harbor facilities.

La Réorganisation De Nos Ports De Commerce (89725 C + D). P. De Rousiers. 7,000 w. Soc D'Encouragement Industrie Nationale — July-Aug., 1918. Suggestions for improving and facilitating commerce by port improvements.

Locks

Construction of Concrete Lock in Hudson River at Troy, N. Y., 1916, in Charge of Col. W. M. Black, Corps of Engineers (89619 B). M. J. McDonough, and others. Ills. 42 pp. Prof Mem—Sept.-Oct., 1918. Reports on various features of the work.

Mississippi-Warrior

Mississippi-Warrior Waterways Service Hailed as Ushering in New Economic Era (89659). Thomas Ewing Dabney. 2000 w. Mfrs Rec—Oct. 24, 1918. Prospects of this new service for which the government appropriated some $8,000,000.

New York

Solving New York's Port Problems (89142 A). Benjamin A. Howes. Map. 2500 w. Mar Rev—Oct., 1918. Proposal for relieving freight congestion at this port.

Seattle Port

The Port of Seattle (89314 A). Charles Philip Morton. Ills. 700 w. Int Mar Eng—Oct., 1918. A terminal harbor of unusual excellence.

Stream Control

A Novel and Economic Method of Controlling Streams (89459). Halbert P. Gillette. Ills. 700 w. Eng & Con—Oct. 9, 1918. System of "check" dams invented by Alvaro A. Pratt.

MISCELLANY

Military Engineering

Fighting with Fire in Ancient Times (89645 A). H. H. Manchester. Ills. 1800 w. Am Mach—Oct 24, 1918. Illustrations from old plates and description of early methods.

The Balkan Theatre of War (89620 B). Douglas Wilson Johnson. Maps & Ills. 30 pp. Prof Mem—Sept.-Oct., 1918. From "Topography and Strategy in the War."

Fortifications as Dependent Upon Advances in Human Knowledge (89621 B). C. T. Sacket. Ills. 22 pp. Prof Mem—Sept.-Oct., 1918. Improvements in weapons causing modifications in methods of attack and defense.

MARINE AND NAVAL ENGINEERING

Concrete Barge

1,000 Ton Reinforced Concrete Barge (89154 A). Ills. 500 w. Engng—Aug. 30, 1918. Vessel launched in the Lake Shipyard, England, is described.

Concrete Coal Barges (89255). J. F. Springer. Ills. 3000 w. Cl Age—Oct. 3, 1918. Survey of the concrete boatbuilding industry.

Concrete Barges Built True to Design Dimensions (89582 A). Ills. 2000 w. Eng News-Rec—Oct. 17, 1918. Special spacers fix wall thickness and rod location.

Standard Concrete Barge for Use on the New York State Barge Canal (89317 A). Ills. 600 w. Int Mar Eng—Oct., 1918. Authorized design. Plans and specifications.

Crews

Can Canada Supply the Crews for Her Merchant Marine? (89344). T. H. Fenner. Ills. 2000 w. Mar Eng, Can—Sept., 1918. Type of man required, the duties, prospects, etc.

Fabricated Ships

Control of Hull Construction of a 5,000-Ton Deadweight Fabricated Steel Ship (89312 A). 1500 w. Int Mar Eng—Oct., 1918. Serial, 1st part. Methods and practices required at yards in ordering materials to facilitate deliveries from steel mills.

"Freedom of the Seas"

The Freedom of the Seas (89195 A). Gerard Fiennes. 5500 w. Roy Soc Arts, Jl—Sept. 13, 1918. Reviews the development, and the history of early seafaring times.

Marine Engines

See same heading under MECHANICAL ENGINEERING, *Combustion Motors.*

Merchant Marine

La Marine De Commerce (89726 C + D). M. E. Bertin. Ills. 13,000 w. Soc D'Encouragement Industrie Nationale—July-Aug., 1918. The world's merchant marine during the war.

Restoration of German Merchant Marine (89475). 1000 w. Naut Gaz—Oct. 12, 1918. From paper by Guaranty Trust Co. on Germany's plans for establishing her economic leadership among the nations.

Oil Engines

New Type of Marine Oil Engine (89313 A). Ills. 1500 w. Int Mar Eng—Oct., 1918. Two-cycle engine with novel features.

Salvage

Le Sauvetage Des Navires Coulés (89707 B). A. Poidlouē. Ills. 3900 w. Génie Civil—Sept. 28, 1918. Methods of raising sunken ships.

Salvage Work in Home Waters (89115 A). From London Morning Post. 1500 w. Aust Min Std—Aug. 22, 1918. Account of some of the exploits which resulted in saving over 400 ships.

Shipbuilding

Building Wooden Ships for the Emergency Fleet Corporation (89587 A). E. A. Suverkrop. Ills. 5000 w. Am Mach—Oct. 17, 1918. Serial, 1st part. Methods used at the Traylor plant at Cornwells on the Delaware.

Great Submarine-Chaser Factory Produces "Eagles," by Indoor Shipbuilding System (89581 A). Ills. 2500 w. Eng News-Rec—Oct 17, 1918 Problem of rapid production solved by special design and quantity manufacture.

"I am 29 Days Old—Look Me Over" (89140 A). Ills. 1500 w. Mar Rev—Oct., 1918. Description of the steel cargo carrier Crawl Keys and its construction.

Some Insufficiently Considered Details of Ship Construction and Equipment (89315 A). C. Waldie Cairns. Read before N-E Coast Inst of Engrs & Shipbuilders. 6500 w. Int Mar Eng—Oct., 1918. Analysis of conditions of yard management and criticizing details of equipment.

Shipbuilding Woods

African Oak and Its Use in Shipbuilding (89474). C. D. Mell. 700 w. Naut Gaz—Oct. 12, 1918. Information concerning this wood, its use, the supply, etc.

Shipyards

A New California Shipyard (89562 A). W. W. Hanscom. Ills. 4500 w. Met Trds—Oct., 1918. Plant of the Pacific Coast Shipbuilding Co. at Bay Point.

Marine De Commerce a Vapeur (89,720 B). E. Bertin. Ills. 4000 w. La Nature—Oct. 5, 1918. Post-war problems in steam navigation. Japanese shipyards.

Smoke Screens

The Yarrow Anti-Submarine Smoke System (89339 A). Ills. 800 w. Engr—Sept. 13, 1918. Describes method of eliminating smoke column. Now in active use on merchant ships.

Unsinkable

Unsinkable Freight Ship of French Design (89316 A). Ills. 500 w. Int Mar Eng—Oct., 1918. Design of M. La Parmentier. Five steel cargo steamers of the type are under construction.

Wooden Ships

The Wooden Ship—The South's Contribution to the New American Merchant Marine (89634). E. T. Hollingworth, Jr. 1800 w. Mfrs' Rec—Oct. 17, 1918. Account of the work that has been accomplished and the outlook.

West Coast Leads in Wooden Ships (89143 A). A. Mobley Sutton. Ills. 1800 w. Mar Rev—Oct., 1918. Account of work accomplished in the shipyards of Oregon and Washington.

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MINING AND METALLURGY

BASE METALLURGY

Copper

The Action of Reducing Gases on Hot Solid Copper (89571 D). Norman B. Pilling. Ills. 2500 w. A I M E, Bul—Oct., 1918. A study of the nature of the action and the conditions under which it occurs.

The Effect of Cold Work on Copper (89330 A). W. E. Alkins. Read before the British Inst. of Metals. 2500 w. Engng—Sept. 13, 1918. An inquiry into the change in tensile strength of copper in the form of wire as it is progressively hardened by cold drawing.

The Spectroscopic Determination of Lead in Copper (89572 D). C. W. Hill, and G. P. Luckey. Ills. 2200 w. A I M E, Bul—Oct., 1918. Development of the method in the factory, giving details of apparatus and its standardization.

Furnace

New Merton Roasting Furnace for Blende (89180 A). Ills. 700 w. Eng & Min Jl—Sept. 28, 1918. A new type adapted for roasting zinc blende but available for other materials.

France

La Métallurgie Française (89723 E). L. Guillet. Charts. 4300 w. Soc Ingénieurs Civils De France—April-June, 1918. Past and future of metallurgy in France. Statistics of iron, steel, copper, lead, zinc, tin, aluminum and nickel.

Metallography

Metallography and the War (89381 A). Zay Jeffries. 2500 w. Chem & Met Eng—Sept. 28, 1918. Production of metals for specific uses; war uses for metallography; new and special fields.

Metallurgical Analysis

Speeding Up Metallurgical Analysis (89377). Harold C. Parish. 4000 w. Comments on the analyst's part in production; selection of rapid and accurate methods, etc.

Zinc

Electrolytic Zinc (89568 D). C. A. Hansen. 1800 w. A I M E, Bul—Oct., 1918. Discussion of C. A. Hansen's paper.

COAL AND COKE

American Coals

Fusibility of Ash from West Virginia Coals (89518). Walter A. Selvig. Tables. 1000 w. Power—Oct. 15, 1918. Results of a general survey, by the Bureau of Mines, of the softening temperatures of the ash from American coals.

Carbocoal

Carbocoal (89569 D). C. T. Malcohnson. 4500 w. A I M E, Bul—Oct., 1918. Discussion of C. T. Malcohnson's paper.

Carbonization

Carbonization Reactions (89530 A). J. W. Cobb. William Young memorial lecture delivered at Glasgow. 5500 w. Colly Ydn—Sept. 27, 1918. Of particular interest to the gas industry.

Carbonization of Coal (89325 A). Wallace Savage. Ills. 2000 w. Chem & Met Eng—Oct. 1, 1918. Rapid advances being made in coal distillation field.

Coal Distillation

The Distillation of Coal in a Vacuum (89359 A). Amé Pictet. 5000 w. Chem & Met Eng—Sept. 25, 1918. Nature of products obtained.

Coal Industry

The Coal Industry's Part in the War (89473). John J. Cornwell. 3500 w. Cl Age—Oct. 10, 1918. Substance of address by Governor of W. Va. at White Sulphur Springs, for the purpose of stimulating coal production.

Conservation

Coal Conservation (89153 A). 3000 w. Engng—Aug. 30, 1918. Editorial review of the final report of the Coal Conservation Committee, and the need of conserving British coal.

The Householder and Clause 7 of the Coal Rationing Order (89524 A). Ed. C. De Segundo. 1400 w. Elec Rev—Sept. 27, 1918. Examination of order and discussion of the comparative values of various forms of fuel.

Wartime Economies (89256). George B. Pryde. 2500 w. Cl Age—Oct. 3, 1918. War economy as applied to coal mining.

Mine Cave

Anthracite Mine-Cave Situation (89125). 4000 w. Cl Age—Sept. 26, 1918. The solution of the Scranton mine-cave problem. Methods proposed and adopted.

New South Wales

Recent Developments in the Coal Fields South of Sydney (89528 A). Dr. J. R. M. Robertson. Map and Ills. Read before Instn. of Min. Engrs. 4800 w. Colly Gdn—Sept. 27, 1918. Physiography of this coalfield.

Production

Increased Production in Wartime (89,257). R. M. Magraw. 2500 w. Cl Age—Oct. 3, 1918. Methods worthy of consideration for increasing coal production.

Pulverized Coal

Excellent Results with Pulverized Coal at Milwaukee (89516). Ills. 2500 w. Power—Oct. 15, 1918. No slag or ash troubles, ease of control, and other beneficial results.

Experience with Pulverized Coal (89,613). 2000 w. Elec Wld—Oct. 19, 1918. How difficulties were overcome in the plant of a Milwaukee utility company.

Notable Stationary Installation of Pulverized Coal (89426). Ills. 2000 w. Ry Age—Oct. 11, 1918. From paper by John Anderson, describing the equipment at the Oneida St. Station, Milwaukee.

Pulverized-Coal Tests Conducted at Milwaukee—I (89631). 1000 w. Elec Rev, Chi—Oct. 19, 1918. Serial, 1st part. Details of installation of the Milwaukee Electric Ry & Lgt Co's plant at Oneida St.

Pulverized Fuel in a Milwaukee Power Plant (89682). John Anderson. Ills. 1500 w. Ry Rev—Oct. 26, 1918. Results.

Screens

A New Type of Screen (89123). M. Raymond. Ills. 1200 w. Cl Age—Sept. 26, 1918. A modified form of the American system of rope transmission which may be used for coal screening.

Tipples

Shipping Facilities at the World's Largest Coal Mine (89122). R. W. Mayer. 2500 w. Cl Age—Sept. 26, 1918. Arrangements at Vesta No. 4 mine near California, Pa., for loading coal barges.

Valley Camp Coal Co.'s Tipple at Parnassus, Penn. (89121). George S. Jaxon. Ills. 2000 w. Cl Age—Sept. 26, 1918. Tipple designed to make four sizes of coal.

Waste

Waste Due to Excessive Ash in Coal (89472). 1800 w. Cl Age—Oct. 10, 1918. A report made by the J. G. White Eng. Corp. on clean coal and the effect of high ash upon thermal efficiency, amount of boiler plant, etc.

GEOLOGY

Arizona

The Jerome District of Arizona (89,178 A). J. R. Finlay. Ills. 6500 w. Eng & Min Jl—Sept. 28, 1918. Serial, 1st part. Broader phases of the geology of this district are discussed.

Ore Deposits

Notes on Certain Ore Deposits of the Southwest (89574 D). W. Tovote. 5000 w. A I M E, Bul—Oct., 1918. Information based on 12 years' experience in the Southwest.

Salt Domes

Origin of the Texas Domes (89577 D). 2500 w. A I M E, Bul—Oct., 1918. Discussion of E. L. De Golyer's paper.

IRON AND STEEL

Alloys

On Magnetic Analysis as a Means of Studying the Structure of Iron Alloys (89546 N). Kōtaro Honda. 43 pp. Ir & St Inst—Sept., 1918. Explains the method of magnetic analysis, giving examples.

Cast-Iron

Laws Governing the Fluidity of Molten Cast Iron (89163). Matthew Ridell. 3500 w. Can Fndman—Sept., 1918. Factors which affect the melting point. Vagaries in cupola operation.

Method for the Prevention of Growth in Grey Cast Iron (89547 N). J. E. Hurst. Ills. 5 pp. Ir & St Inst—Sept., 1918. Causes of growth and methods of prevention.

Phosphorus in Malleable Cast Iron (89552 N). J. H. Teng. Ills. 19 pp. Ir & St Inst—Sept., 1918. Investigations undertaken to examine the effect of proportions of phosphorus varying from 0.05 to 0.5 per cent. on the mechanical properties of malleable cast iron.

Furnace Design

The Principles of Open-Hearth Furnace Design (89539 N). Charles H. F. Bagley. Ills. 19 pp. Ir & St Inst—Sept., 1918. Discusses the subject of design from the scientific and practical viewpoints.

Furnaces

The Principles of Open-Hearth Furnace Design (89203 A). Charles H. F. Bagley. Ills. 4500 w. Ir & Cl Trds Rev—Sept. 13, 1918. (Abstract.) Points of importance in designing the furnace, its management, etc.

Ingots

The Development of the Sand-Cast Forging-Ingot (89564 A). W. L. Booth. Ills. 900 w. Met Trds—Oct., 1918. A sand-cast ingot is being produced in San Francisco that is equal to best Eastern ingots.

Iron Ores

Metalliferous Ores of the Iron and Steel Industry (89714 A). H. C. H. Carpenter. 1000 w. Nature—Sept. 5, 1918. Abstract of report of Dept. of Scientific and Industrial Research, England.

Iron Problem

The Foundrymen's Iron Problem (89594). C. J. Stark. 5400 w. Ir Trd Rev—Oct. 17, 1918. How the war industries board handles distribution.

Laboratory

Speeding Up the Steel Works Laboratory (89379 A). H. C. Kimber. Ills. 2500 w. Chem & Met Eng—Sept. 28, 1918 Suggestions and methods of analysis of value in the production of electric steel.

Milwaukee

Milwaukee Historic in Iron Trade (89278). Ills. 3000 w. Ir Trd Rev—Oct. 3, 1918. Sketch of the metal industries.

Pig Iron

Great Importance of Buying Good Pig Iron (89160). E. Standiford. 1500 w. Can Fndman—Sept., 1918. Careful analysis required for strong castings.

Reactions

Some Experiments on the Reaction Between Pure Carbon Monoxide and Pure Electrolytic Iron Below the A-1 Inversion (89541 N). H. C. H. Carpenter and C. Coldron Smith. Ills. 52 pp. Ir & St Inst—Sept., 1918. Experimental research work, explaining its objects.

Semisteel

Tracing the Development and Use of Semisteel (89161). 1200 w. Can Fndman—Sept., 1918. Proof of its value.

Slag

Slag Control in the Iron Blast-Furnace by Means of Slag Viscosity Tables (89346 A). Alex. L. Field. 7500 w. Chem & Met Eng—Sept. 15, 1918. Method of using the slag viscosity tables illustrated by examples.

Steel

Influence of Hot-Deformation on the Qualities of Steel (89542 N). Georges Charpy. Ills. 18 pp. Ir & St Inst—Sept., 1918. Experiments to determine the influence of hot-working on the properties of steel.

On the Cooling of Steel in Ingot and Other Forms (89543 N). J. E. Fletcher. Ills. 40 pp. Ir & It Inst—Sept., 1918. Investigation of the laws which govern the freezing and cooling of steel in metal and sand molds.

Composition and Properties of Steels (89422 A). Howard Ensaw. 2500 w. Am Mach—Oct. 10, 1918. Study of steel alloys in common use. Suggestions.

The Influence of Some Elements on the Tenacity of Basic Steel, with a New Formula for Calculating the Maximum Load from the Composition (89550 N). Andrew McWilliam. 12 pp. Ir & St Inst—Sept., 1918. Results of investigations.

Steel Works

Broken Hill Proprietary Company's Iron and Steel Works, Newcastle, N. S. W. (89116 N). Ills. 5500 w. Chem Eng & Min Rev—Aug. 5, 1918. Detailed description.

Proposed Iron and Steel Works in Queensland (89117 N). E. C. Saint-Smith. Ills. 4500 w. Qnsd Gov Min Jl—Aug., 1918. Report of the government geologist concerning the occurrences of iron in this state.

Stellite

Stellite Developed by Arc Furnace (89,595). Elwood Haynes. Ills. 1000 w. Ir Trd Rev—Oct. 17, 1918. Now produced in commercial quantities in electrically-heated crucibles.

Tuyeres

A Few Notes on Bosh Tuyeres (89545 N). J. Hollings. Ills. 8 pp. Ir & St Inst—Sept., 1918. Circumstances which led to their adoption and results of experience.

Warping

Note on the Warping of Steel Through Repeated Quenching (89553 N). J. H. Whiteley. Ills. 1000 w. Ir & St. Inst—Sept., 1918. Describes results of quenchings on a cylindrical piece of soft steel.

Waste Heat

See same heading under MECHANICAL ENGINEERING, *Steam Engineering*.

MINE OPERATION

Conveyors

A Reciprocating Underground Coal Conveyor (89470). J. F. K. Brown. Ills. 1800 w. Cl Age—Oct. 10, 1918. Used successfully in coal beds having an inclination.

Deep Mining

Presidential Address at Nottingham Meeting of the Institution of Mining Engineers (89197 A). George Blake Walker. 4000 w. Colly Gdn—Sept. 13, 1918. Deals particularly with the conditions of mining at great depths.

Haulage

Haulage Experience (89204 A). James Gilchrist. Read before Scottish Br. of Natl. Assn. of Colly. Mgrs. Ills. 3000 w. Ir & Cl Trds Rev—Sept. 13, 1918. Details of best known methods now in use in connection with underground haulage.

Hydraulic Stowing

Some Primary Considerations in Hydraulic Stowing in Mines, with a Note Particularly Relating to the Coal-fields of Bihar (89592 N). C. A. John Henry. 6 plates. 38 pp. Min & Geol Inst of India, Trans—April, 1918. Factors to be taken into consideration.

Mine Buildings

Pisé de Terre Mine Buildings (89273 A). 1500 w. Eng & Min Jl—Oct. 5, 1918. Details of a method of construction of buildings in mining camps, by means of rammed earth

Mine Efficiency

Increasing Coal Mine Efficiency—I (89,604). Charles E. Stuart. Charts. 2500 w. Cl Age—Oct. 17, 1918. Serial, 1st part. Problems of the power generation and distribution system.

Mine Fans

Origin and Development of the Ventilating Fan (89171). 2200 w. Cl Age—Oct. 10, 1918. Types in use and advantages of steel-plate faces.

Mine Hoists

Drum Shapes as Affecting the Mine Hoist Duty Cycle and Motor Rating (89,412 D). F. L. Stone. Ills. 18 pp. A I E E, Pro—Oct., 1918. Standardization considered impossible.

Mine Lamps

Advantages in Use of Permissible Electric Lamps in Non-Gaseous Mines (89,219 A). George H. Deike. 1800 w. Sfty Eng—Oct., 1918. Characteristics of a non-gaseous mine; reasons for success of electric cap lamps.

The Chance Acetylene Safety Lamp (89529 A). William Maurice. Ills. 2200 w. Colly Gdn—Sept. 27, 1918. Describes a new lamp and gives information concerning its efficiency.

Mine Valuation

Valuation of Mines in Arizona (89,488 A). E. Jacobs. 1800 w. Eng & Min Jl—Oct. 12, 1918. Describes the Arizona method of classifying mines.

The Valuation of Ore Reserves (89,196 A). James Whitehouse. Ills. 1700 w. Colly Gdn—Sept. 13, 1918. Serial, 1st part. Outlines methods used on the Witwatersrand, and describes in detail the method of sampling the gold-bearing reefs.

Mine Workers

The Human Side of Mining Engineering (89406 N). James Furman Kemp. 10 pp. Univ Mo, Bul—June, 1918. Commencement address, May 24, 1918. Ways in which loyalty of workers to the company or firm may be secured.

Mining Supplies

Purchase of Mining Machinery and Supplies (89652). C. E. Bowron. 2200 w. Cl Age—Oct. 24, 1918. Suggestions for judicious purchase.

Shafts

Shaft Sinking at the Seneca Mine (89,179 A). W. V. Featherly. Ills. 1000 w. Eng & Min Jl—Sept. 28, 1918. Record established at Mohawk, Mich.

MINES AND DISTRICTS

Alaska

Mining in Alaska Under War Conditions (89272 A). P. C. Stoess. 4000 w. Eng & Min Jl—Oct. 5, 1918. How present economic conditions are affecting the mining industry. Gloomy outlook.

Notes on Mining in Alaska (89676 A). C. Carleton Semple. 4500 w. Eng & Min Jl—Oct. 26, 1918. Résumé of mining conditions and synopsis of the present operations of important companies.

Manitoba

Mining in Northern Manitoba (89617 A). J. A. Campbell. Ills. 2000 w. Eng & Min Jl—Oct. 19, 1918. History of the region and details of its development.

Tonopah

Effect of the War Upon Tonopah Mining (89271 A). Jay A. Carpenter. Ills. 2500 w. Eng & Min Jl—Oct. 5, 1918. Comparison of operating costs for the years 1913 and 1917 at Tonopah, Nev., silver mines.

MINOR MINERALS

Magnesium

Development of the Magnesium Industry (89558 A). Leonard Waldo. 2000 w. Chem & Met Eng—Oct. 15, 1918. Its uses and the future outlook.

Magnesium (89383 A). 1000 w. Chem & Met Eng—Sept. 28, 1918. Some of its present commercial applications.

Manganese

The Arkansas Manganese Field (89,480 A). Dwight E. Woodbridge. 1200 w. Eng & Min Jl—Oct. 12, 1918. Discusses the Batesville district.

Molybdenum

Molybdenum (89118 N). William Poole. 4500 w. Qnsd Gov Min Jl—Aug., 1918. Production, properties and uses.

Nitrates

Determination of Nitrates in Caliche and Its Products (89487 A). T. E. Clennell. 2200 w. Eng & Min Jl—Oct. 12, 1918. Methods in vogue in Chile. Results of a research to determine the accuracy.

Phosphate

Acid Phosphate Now and After the War (89464). Charles A. Whittle. 1800 w. Mfrs' Rec—Oct. 10, 1918. Comparative values of rock phosphate and acid phosphate.

Potash

A Wet Process for Extracting Potash from Cement Dust (89363 A). J. G. Dean. Ills. 7500 w. Chem & Met Eng—Sept. 26, 1918. A humidifying process for precipitation of potash-bearing dust from cement kilns.

Extraction of Potash from Kelp (89,361 A). C. A. Higgins. 2000 w. Chem & Met Eng—Sept. 26, 1918. Revival of the industry; old and new methods, etc.

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Literature of the Potash Industry 1912-1917 (89364 A). F. W. Bruckmiller. 2500 w. Chem & Met Eng—Sept. 26, 1918. General review of more important articles published from 1912 to 1917.

Potash as a By-Product (89362 A). J. S. Grasty. Ills. 3000 w. Chem & Met Eng—Sept. 26, 1918. Southern iron ores and fluxes considered as a domestic source.

Potash from Alunite in Utah (89368 A). John W. Hornsey. 1500 w. Chem & Met Eng—Sept. 26, 1918. Deposits being worked in Utah; methods proposed for treatment, etc.

Potash in Nebraska (89560 A). J. M. Lliteras. Ills. 1800 w. Chem & Met Eng—Oct. 15, 1918. Reviews conditions at the plants producing potash from lake brines.

The Cottrell Process for Potash Recovery (89367 A). Linn Bradley. 4500 w. Chem & Met Eng—Sept. 26, 1918. Collection by electrical precipitation of volatile vapors of alkali salts from blast furnaces and cement kilns.

Potash from Searles Lake (89360 A). Alfred de Ropp, Jr. Ills. 3000 w. Chem & Met Eng—Sept. 26, 1918. Account of development of a project for the recovery of potash from the saline waters of a California lake.

The Kelp-Potash Plant of the Lorned Manufacturing Company (89365 A). Leslie H. Thompson. Ills. 2800 w. Chem & Met Eng—Sept. 26, 1918. An interview giving information of methods in California.

The Potash Industry of Germany (89,366 A). Wallace Savage. Ills. 3000 w. Chem & Met Eng—Sept. 26, 1918. Theories of origin and description of the Strassfurt salts deposit; the present status of the industry.

Tin

A Statistical Summary of Tin (89384 A). Edith M. Miller. Ills. 6000 w. Chem & Met Eng—Sept. 28, 1918. Reviews the development of its economic uses.

OIL AND GAS

Fuel Oil

California Petroleum as a Fuel Oil (89497). Thomas J. Royer, with descussion. Ills. 4800 w. Natl Engr—Oct., 1918. History of development, study of use in steam boiler practice, and suggestions for satisfactory operation.

El Petróleo como combustible (89717 A). J. R. Pérez. 3200 w. Rev Soc Cubana De Ingenieros—Sept., 1918. Crude oil for fuel, its properties, fuel value and methods of burning.

Gasoline

Recovery of Gasoline from Casing-Head and Natural Gas (89284 A). Paul Diserens. Ills. 4000 w. A S M E, Jl—Oct., 1918. Process most used in the recovery is described, with suggestions for improvements.

Oil Fields

Water Troubles in the Mid-Continent Oil Fields, and their Remedies (89576 D). Dorsey Hager and G. W. McPherson. Ills. 2500 w. A I M E, Bul—Oct., 1918. Analysis of water trouble and remedies.

Oil Storage

The Storage of Petroleum (89531 A). Ills. 3500 w. Engng—Sept. 20, 1918. Information from report of the U. S. Bureau of Mines, explaining the system in general use in the United States.

Oil Wells

Cement Plugging for Exclusion of Bottom Water in the Augusta Field, Kansas (89575 D). H. R. Shidel. Ills. 1400 w. A I M E, Bul—Oct., 1918. Results obtained from the preliminary cementing of wells to cut off the bottom water.

ORE DRESSING

Arizona Plant

The United Verde Extension Mining Company's Smeltery and Converter Plant (89614 A). F. E. Nichols. Ills. 1200 w. Eng & Min Jl—Oct 19, 1918. Plans and information concerning a notable Arizona metallurgical plant.

Bunker Hill

Smelting and Lead Refining at the Bunker Hill Plant (89678 A). C. T. Rice. Ills. 1500 w. Eng & Min Jl—Oct. 26, 1918. Fourth of a series of articles on the design and operation of the Bunker Hill & Sullivan plant.

Flotation

The Terry Differential Flotation Process (89349 A). 1000 w. Chem & Met Eng—Sept. 15, 1918. Based on the discovery that ammonia in solution promotes oxidation of metallic sulphides by air introduced into the pulp.

Laboratory

The Ore Dressing Laboratory of the Haileybury School of Mines (89409 N). A. E. Flynn. Ills. 1500 w. Can Min Inst, Bul—Oct., 1918. - Details of plant and equipment.

Sintering

Sintering and Charge Delivery at the Bunker Hill Plant (89485 A). C. T. Rice. Ills. 3500 w. Eng & Min Jl—Oct. 12, 1918. Third of a series of articles on the design and operation of the Bunker Hill & Sullivan smeltery and refinery.

Standardization

The Distinction Between Extraction and Recovery (89677 A). A. W. Allen. 1500 w. Eng & Min Jl—Oct. 26, 1918. Serial, 1st part. A plea for more scientific differentiation between terms used in hydrometallurgical operations.

PRECIOUS METALLURGY

India

Air Blasts in the Kolar Gold Field, India (89570 D). 5000 w. A I M E, Bul—Oct., 1918. Discussion of E. S. Moore's paper.

PLACER MINING

Gold

Gold Dredging in the United States (89403 B). Charles Janin. Ills. 214 pp. U S Bur Mines—Bul 127. Summarizes the development of the gold dredge, giving essential features of present-day dredges and methods.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION

British Railways

British Railways Under War Conditions (89338 A). 2500 w. Engr—Sept. 13, 1918. Serial, 1st part. The present number deals with legislative connection between the railways and the naval and military authorities.

Coaling

A New Design for Engine Coaling Facilities (89259). Ills. 1200 w. Ry Age—Oct. 4, 1918. Economies effected in track capacity and car supply on the Erie.

Engineers

Will Railroads Experience a Shortage of Engineers? (89427) 1500 w. Ry Age—Oct. 11, 1918. Discussion based on data from railroads and technical schools.

Federal Control

What the Future Holds in Store for the Railroads (89260). 3000 w. Ry Age—Oct. 4, 1918. Views of Samuel Untermyer and of Francis H. Sisson on effect of Federal control on securities and fate of carriers after war.

Signaling

Winter Maintenance of Primary and Storage Battery (89389). A. G. Shaver. 1700 w. Ry Sig Engr—Oct., 1918. Pointers on winter work covering the various types, condition of the track, etc.

Maintenance of Electric Interlocking in Winter (89390). A. W. Seymour. 1200 w. Ry Sig Engr—Oct., 1918. Methods in practice. Preparations for winter.

Train Shocks

Shocks in Long Passenger Trains (89405 A). Robert Burgess, with discussion. 13 pp. S & S W Ry Cb, Pro—July, 1918. Analysis of shocks due to deceleration and to acceleration.

Transfer Railroads

Operating Methods of Transfer Railroads (89298). 3500 w. Ry Rev—Oct. 5, 1918. Analysis of existing conditions and suggestions for improvements. From paper by E. H. Lee to Am. Ry. Eng. Assn.

Transportation

Secretary Redfield on the Trinity of Transportation (89465). William C. Redfield. 3000 w. Mfrs' Rec—Oct. 10, 1918. Address before the Regional Chairmen of the Highway Transport Committee of the Council of National Defense. Importance of railway, waterway and highway transportation.

Traveling Engineers

Traveling Engineers' Convention (89443 A). 11 pp. Ry Mech Engr—Oct., 1918. Fuel conservation and other important problems discussed at Chicago. Addresses, reports, etc.

Winter Maintenance

Winter Maintenance of Lamps, Motor Cars and Tools (89392). Caleb Drake. 2000 w. Ry Sig Engr—Oct., 1918. Care needed; suggestions.

MOTIVE POWER AND EQUIPMENT

Cars

Heavy Freight Cars for a Narrow Gage Railway in India (89447 A). Ills. 1000 w. Ry Mech Engr—Oct., 1918. Details of all-steel high-capacity cars.

U. S. R. A. Standard Baggage Cars (89444 A). Ills. 1000 w. Ry Mech Engr—Oct., 1918. All steel construction.

Railroad Administrations Standard Baggage Cars (89167). Ills. 1200 w. Ry Age—Sept. 27, 1918. Designs for 60 ft. and 70 ft. cars of all-steel construction.

Draft Gears

Draft Gears Should Be Maintained (89445 A). L. T. Canfield. 1500 w. Ry Mech Engr—Oct., 1918. Periodical inspection and repairs required for proper protection to the car and to the lading.

Proper Draft-Gear Maintenance (89208). L. T. Canfield. 1200 w. Ry Rev—Sept. 28, 1918. A report of five tests of gears; recommendations as to inspection and repair.

Electrification

Electrification of the Central Argentine Railway (89515). Ills. 2500 w. Power—Oct. 15, 1918. Electrification to deal with suburban traffic near Buenos Aires.

Heavy Electric Traction on the Central Argentine (89345). Ills. 4000 w. Elec Ry Jl—Oct. 5, 1918. An up-to-date electrified section serving suburbs of Buenos Aires.

Power Supply for the Central Argentine Electrification (89479). Ills. 2500 w. Elec Ry Jl—Oct. 12, 1918. Supplies traction, lighting, and other requirements in the suburbs of Buenos Aires.

French Equipment

Difficulties in Handling French Equipment (89633). J. N. McVey. 4000 w. Ry Rev—Oct. 19, 1918. Account of trials encountered by American railway engineers.

Journal Box Packing

The Journal Box Packing Situation (89440 A). 2000 w. Ry Mech Engr—Oct., 1918. Materials used and possible means of overcoming shortage.

Locomotive Crane

Grue-Locomotive De 35 Tonnes (89703 B). Ills. 1000 w. Génie Civil—Sept. 14, 1918. 35-ton locomotive crane for use behind the lines in France.

Locomotives

First Standard 0-8-0 Switcher (89442 A). Ills. 1200 w. Ry Mech Engr—Oct., 1918. Total weight 214,000 lbs.; tractive effort 55,000 lbs.

Heavy Mallet Compound for Virginian Railway (89300). Ills. 1500 w. Ry Rev—Oct. 5, 1918. Describes the fifth of a series of designs of heavy Mallet type locomotives.

Heavy Mallet Locomotives for the Viginian (89598). Ills. 1000 w. Ry Age—Oct. 18, 1918. Built for operation on heavy grades.

Some Recent American Freight Locomotives (89343 A). Ills. 2000 w. Engr—Sept. 13, 1918. Three locomotives of different types recently built by Baldwin Locomotive Works for freight service.

U. S. R. A. Standard Six-Wheel Switching Locomotive (89424). Ills. 1000 w. Ry Age—Oct. 11, 1918. The first of the smallest government engines to be built.

Tonnage Rating

Tonnage Rating of the Standard Locomotives (89261). H. S. Vincent. 800 w. Ry Age—Oct. 4, 1918. Charts from which the maximum hauling capacity in tons of 2,000 lbs. can be read directly for any combination of speed and grade within given limits.

PERMANENT WAY AND BUILDINGS

Curved Resistance

The Mechanics of Curved Resistance (89556). From a paper by J. G. Sullivan. Ills. 5000 w. Ry Rev—Oct. 12, 1918. A study covering older theories with data of recent experiments.

Essential Work

Essential Work (89600). C. A. Morse. 1500 w. Ry Age—Oct. 18, 1918. Suggestions for taking care of railway business under present conditions of shortage of labor and materials.

Rails

Common Defects in Rail (89301). From paper by C. W. Gennet, Jr., before Roadmaster's Convention. 3000 w. Ry Rev—Oct. 5, 1918. Best avoided by care in manufacture and rigid inspection.

Stations

Toronto Union Station An Imposing Structure (89466). Ills. 1000 w. Can Engr—Oct. 10, 1918. Most important building of the kind in Canada. Will be ready for use next spring.

Terminals

Preparation for Winter on a Busy Terminal (89391). F. L. Wells. 1500 w. Ry Sig Engr—Oct., 1918. Advance preparations and methods of handling the work.

Unification of Terminal Facilities in the West (89262). 2500 w. Ry Age—Oct. 4, 1918. Changes in operation to prevent congestion.

Unified Operation of Railroad Terminals (89169). 3000 w. Ry Age—Sept. 27, 1918. Abstract of preliminary report of Am. Ry. Engng. Assn. Fundamental principles.

Some Features of Construction of the St. Paul Union Depot (89213 A). Ills. 2000 w. Af Eng Socs Minn, Bul—Sept., 1018. Items involved in connection with this new passenger terminal, such as track changes, retaining walls, bridges, tunnels, train sheds, etc.

Engineering of the St. Paul Passenger Terminal (89679). Ills. 2000 w. Ry Rev—Oct. 26, 1918. New station; elevated tracks eliminating grade crossings; coach yard and locomotive terminal.

Unit Operation of Railroad Terminals (89207). 5000 w. Ry Rev—Sept. 28, 1918. Recommendations of the A. R. E. A. committee as to unit operation in large cities.

Urges Study of Unit Operation of Railroad Terminals in Large Cities (89249 A). 5000 w. Eng News-Rec—Oct. 3, 1918. Recommends investigation by representative committees.

Ties

Present Aspect of the Tie Situation (89299). From remarks by John Foley at Roadmasters' convention. 1800 w. Ry Rev—Oct. 5, 1918. Principles governing the buying and specification of cross ties and difficulties of price fixing.

Tool Repairs

Repairing Locomotive Fittings (89420 A). Frank A. Stanley. Ills. 800 w. Am Mach—Oct. 10, 1918. Different styles of reamers for use on locomotive fittings.

Track Maintenance

L'Entretien Des Voies De Chemins De Fer (89722 E). M. A. Moutier. Ills. 1600 w. Soc Ingénieurs Civils De France—April-June, 1918. Maintenance of railway track.

Workshops

Locomotive Workshops at Eveleigh, N. S. W. (89520 N). Ills. 2200 w. Comwh Engr—Sept., 1918. Serial, 1st part. Detailed description of shops and equipment.

ROADS AND PROJECTS

Alaska

Railroad Construction Progress in Alaska (89297). Ills. 1500 w. Ry Rev—Oct. 5, 1918. Serial, 1st part. Account of construction of the government railroad between Anchorage and Seward.

Brazil

The Development of the Brazilian Railways (89599). Ills. 2000 w. Ry Age—Oct. 18, 1918. Information from a report on the railways of Brazil.

Kentucky

The B. & O. Completes the Long Fork Railway (89425). A. C. Clark. Ills. 800 w. Ry Age—Oct. 11, 1918. An important line in the development of the coal resources of eastern Kentucky.

Paris-Havre

Paris-Le Havre (89719 B). L. De Launay. Ills. 1800 w. La Nature—Sept. 21, 1918. Railway communication, and project for double tracking existing lines.

TRAFFIC

Atlantic Ports

Traffic Conditions at Eastern Ports (89680). 2500 w. Ry Rev—Oct. 26, 1918. Survey of operations at Atlantic ports encouraging.

Express

The American Railway Express Company (89557). E. A. Stedman. 2000 w. Ry Rev—Oct. 12, 1918. Outlines Government's scheme of organization for handling express business during the war.

Freight

Freight Transportation Without Rehandling (89481). Ills. 900 w. Elec Ry Jl—Oct. 12, 1918. The Bonner rail wagon system and how it operates.

Rates

Railway Rates (89653 N). R. A. Lehfeldt. 4500 w. So Af Instn Engrs, Jl—Sept., 1918. Discussed from an economic point of view.

MISCELLANY

Employees

Making Americans on the Railroad (89423 A). Samuel Rea. Ills. 2500 w. Am Mach—Oct. 10, 1918. Methods and results in fitting foreign-born employees of the Penn. R. R. to become loyal citizens of the United States.

Standardization

Standardization of Forms, Southern Pacific Co. (89681). E. B. Stewart. 3000 w. Ry Rev—Oct. 26, 1918. Systematic revision of stationery items.

STREET AND ELECTRIC RAILWAYS

Acceleration

Acceleration of Cars (89507 A). Lynn G. Riley. 1800 w. Elec Jl—Oct., 1918. Advantages and limitations of automatic systems of control, and the use of hand control.

Car Operation

Principles of Economical Car Operation (89500 A). F. E. Wynne. 700 w. Elec Jl—Oct., 1918. Practices which help to conserve fuel and labor and improve service.

Cars

The First Universal Car (89670). Ills. 2000 w. Elec Ry Jl—Oct. 26, 1918. Preliminary details and general design of car submitted by War Industries Board to Housing Bureau.

Crippled Workers

The Disabled Soldier in Electric Railway Service (89212). Ills. 2500 w. Elec Ry Jl—Sept. 28, 1918. Account of useful work accomplished by one-arm men, blind men, and others.

Economies

War Time Economies for Electric Railways (89501 A). Clarence Renshaw. 5000 w. Elec Jl—Oct., 1918. Considers the skip-stop system, overlapping lines, train operation, through routes, coasting, etc.

Electric Railways

Prompt Relief Needed by the Electric Railway (89498 A). M. C. Brush. 1200 w. Elec Jl—Oct., 1918. Explains seriousness of present situation.

Extensions

How Public Service Railway Is Helping Build Ships in Newark Vicinity (89671). Ills. 4000 w. Elec Ry Jl—Oct. 26, 1918. New facilities costing more than $800,000, for hauling war workers.

Freight

The Electric Railway—A Potential Factor in Relieving Freight Congestion (89502 A). A. B. Cole. Ills. 1700 w. Elec Jl—Oct., 1918. Importance of developing freight haulage.

Railway Motors

Operation of Ventilated Motors Under Snow Conditions (89505 A). R. E. Ferris. Ills. 1800 w. Elec Jl—Oct., 1918. Classes and effect of snow, classes of service, etc.

Seeking for the Best Railway Motor (89499 A). B. G. Lamme. 1500 w. Elec Jl—Oct., 1918. Study of car efficiency and the service the electric motor must meet.

Single vs. Twin Armature Motors (89509 A). J. M. Labberton. Ills. 1500 w. Elec Jl—Oct., 1918. A comparison.

The Application of the Ventilated Railway Motor (89504 A). S. B. Cooper. 1000 w. Elec Jl—Oct., 1918. Remarkable reduction in weight and other advantages. Characteristics.

The Twin Armature Motors (89510 A). Gearld F. Smith. Ills. 1500 w. Elec Jl —Oct., 1918. Details of motors for the Chicago, Milwaukee, and St. Paul direct-current locomotives.

Safety Cars

Fort Worth Still Blazes the Trail (89210). Ills. 1500 w. Elec Ry Jl—Sept. 28, 1918. Benefits from the use of safety cars.

Less Fuel, Less Personnel, More Business at Tampa (89211). Ills. 1800 w. Elec Ry Jl—Sept. 28, 1918. Results from service of safety cars.

The Success of the Safety Car (89503 A). G. M. Woods. Ills. 3000 w. Elec Jl—Oct., 1918. Features that contribute to its economical operation.

Safety Devices

Simple Door Signaling and Interlocking Connections (89506 A). A. H. Candee. Ills. 1000 w. Elec Jl—Oct., 1918. General principles and wiring arrangements outlined.

Switches

Automatic Track Switches Release Men for Other Work (89608). R. C. Cram. Ills. 4000 w. Elec Ry Jl—Oct. 19, 1918. A study of the development and present status of automatic and remote control track switches.

Way Department

Way Department Requires Particularly Complete Organization (88271). R. C. Cram. Charts. 2000 w. Elec Ry Jl—Aug. 17, 1918. Requires closest co-operation with other departments, strict discipline, etc.

BOOK NOTICES

ELEMENTS OF MACHINE DESIGN, by Henry L Machman. Size, 6 x 9; 252 pp.; ills. John Wiley & Son, Inc., New York and London. This is a text book on machine design. The author is associate professor of kinematics and machine design at Armour Institute, Chicago, and while his book is written primarily for the students of that institution, it combines a number of features that will recommend it to teachers of this subject in general. A large number of illustrations serve to make clear the principles evolved in the text and while mathematical expressions are used throughout, they are in the form of simple equations and formulas readily understood by any one who has qualified in simple algebra. Most of the topics treated are made more valuable for the students' understanding by means of the problems that are given to be worked out in connection with the text. The strength of materials is treated in the simplest manner possible consistent with a proper understanding of other topics that follow it in the book. Considerable attention is devoted to screw fastenings and riveted joints. The subject of couplings and clutches is also treated with examples of the commoner types. There is only a brief reference to the application of power transmission through belts and pulleys and it would seem as if this part of the book might have been somewhat more liberally treated, especially as a separate chapter is devoted to rope transmission as well as one to chain gearing. On the whole the book is an addition to the literature intended for technical schools, but one feels that it might have been made more complete by the amplification of certain of its subdivisions.

MODERN MANAGEMENT APPLIED TO CONSTRUCTION, by Daniel J. Hauer. Size, 6 x 9; 104 pp. McGraw-Hill Company, Inc., New York; Hill Publishing Company, London. This is a brief treatise on management as applied to the handling of materials and labor on construction jobs. There are two chapters devoted to an explanation of modern management which point out the contrast between the necessities of the present day and those of the past in this respect. Advice is given on the fundamental operations necessary in undertaking a large piece of construction work, and there is a limited amount of space given to motion studies and time studies, particularly as applied to shovelling operations. Improved methods of bookkeeping also are described and recommended. Considerable space is devoted to the subject of systematizing construction in general, emphasizing certain details regard ing means of recording progress of the work and general activities of the men employed.

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